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# SCIENTIFIC AMERICAN

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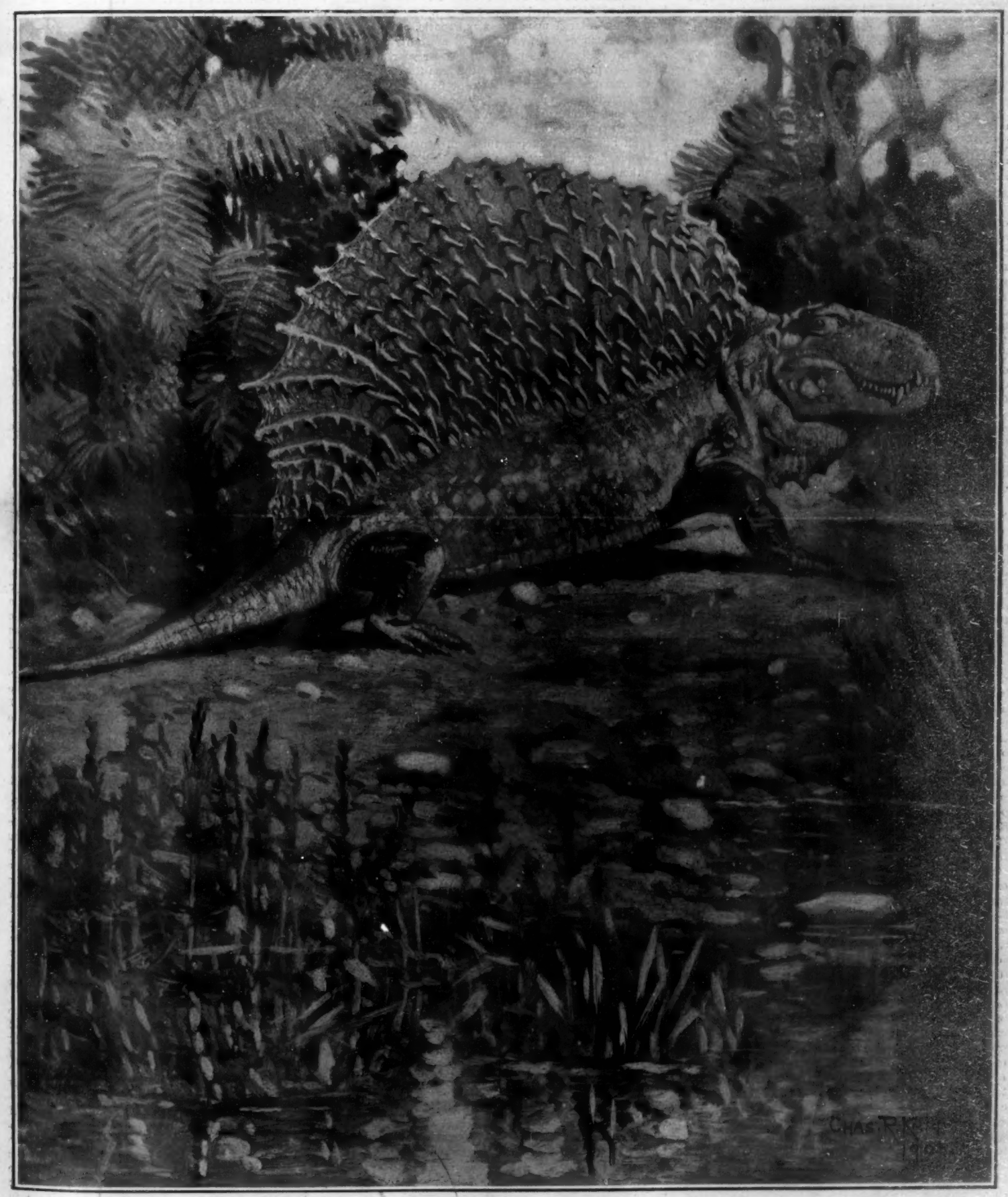


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**An Extinct, Flesh-Eating, Crawling Monster That Made Life Unpleasant for the Texan Lizards of His Day. Why Nature Gave Him a Spiny Crest No One Knows. Perhaps This Curious Excrescence Was a Means of Impaling Enemies Whose Too Aggressive Impulses Prompted Them to Leap on His Back.**

A PREHISTORIC INHABITANT OF TEXAS. HOW NAOSAURUS APPEARED TWELVE MILLION YEARS AGO.—[See page 368.]

# SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, MAY 4, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## ACCELERATING RATE OF GROWTH OF OUR COMMERCE.

In a general way we all understand that the growth of commerce in the United States is proceeding at an accelerating rate; but it takes the actual figures, as published from time to time in the government documents, to impress upon us just how marvelous this growth has become. A volume recently issued by the Department of Commerce and Labor gives us a bird's eye view of the increase of foreign trade, as shown by the total imports and exports annually from 1790 to 1907. The magnitude of our commerce is shown by the fact that its total value for the 117 years under consideration reaches the stupendous sum of 80 billions of dollars, of which 37½ billions represent the value of imports and 42½ billions the value of exports. The most striking fact about these figures next to their magnitude is, that the greater part of this commerce is to be credited to the last two decades; for of the 42½ billion dollars' worth of merchandise exported since 1790, 21½ billions or over one-half is credited to the twenty years beginning with 1887, and 14 billions to the ten years beginning with 1897. Here, in this last statement, is something that may well give us pause; for it takes these carefully-compiled government statistics to render it credible, that one-third of the total exports for a period of 117 years is due to the commercial expansion of the last ten years. Of the 37½ billions representing the aggregate imports since 1790, about one-half came in during the twenty-two years beginning with 1885.

## THE COMMERCIAL SUPREMACY OF NEW YORK.

Apropos of the rapid growth of our commerce, it will be gratifying to the residents of New York to learn that this city easily maintains its commercial pre-eminence. A summarization of the business of the past year by ports of entry and departure, shows that New York continues to handle about two-thirds of the entire foreign commerce of the United States. Next in importance comes Boston with 7 per cent, followed by New Orleans with 6 per cent, Galveston 5¾ per cent, Philadelphia 5 per cent, Baltimore 4¾ per cent, San Francisco with not quite 3 per cent, Savannah 2¼ per cent, Puget Sound 2 per cent, and Buffalo and Detroit each with a little over 1 per cent, the above percentages having reference to a total foreign commerce of $2,970,000,000. If we consider the exports only, the percentage list of the total exportations, by ports, shows New York to be first with 35 per cent to its credit. The general currents of the export trade are shown by the figures of the exports arranged by principal sections of the country; according to which, Atlantic coast ports are credited with 61 per cent, Gulf ports 21 per cent, northern border and lake ports 10 per cent, Pacific coast ports 6 per cent, and Mexican border ports 2 per cent. The Bureau of Statistics is to be congratulated on the new and more scientific classification of the year's commerce which was adopted by the Department last year, and receives its first publication in the present volume. All articles are now subjected to a twofold classification to show, first, the condition in which they enter commerce, whether raw or manufactured, and, if the latter, whether partially manufactured or wholly manufactured; and second, whether intended for food or to meet other necessities of life. This classification makes it possible to trace the development of domestic industry in each group of articles, and ascertain what changes are occurring in the position of the United States, as regards its ability on the one hand to supply its own requirements for food or manufactures, and on the other to sell in foreign markets domestic products in competition with those of other countries.

## HEALTH CONDITIONS AT PANAMA.

The last monthly report of the Sanitary Department at Panama, which has been doing such successful work under Col. Gorgas, shows that health conditions continue steadily to improve, both in the laboring force and the civil population. The two causes of highest mortality among the working force were pneumonia, which was responsible for twenty-six deaths, and malarial fever, from which fifteen deaths occurred. In the total working force of 5,554 white Americans there were but two deaths during the month, one from fever and the other from consumption; although the consumption case cannot be charged to conditions at the Isthmus, seeing that the patient was well advanced in that disease when he arrived from the United States, and worked only a few days before being entered upon the sick reports. The present conditions would give a rate of mortality for the American whites of 4.2 per thousand per year, which, if we bear in mind how pestilential was the condition of the canal zone when the present Sanitary Department took charge, must certainly be considered to be a most creditable result. The average sick rate also continues to fall; for whereas in August last there was an average of 42 per thousand constantly sick, in January of this year the figure had fallen to 26 per thousand, and in February to 24 per thousand. There were three cases of smallpox during the month; but two of these were taken off incoming ships by the Quarantine Department, and only one originated on the Isthmus. In the latter case all the usual precautions of disinfecting and isolation were observed, and no further cases occurred. There has been no case of yellow fever on the Isthmus since May of 1906. It is evident from this report that, when the Department claims for the canal zone health conditions that compare favorably with those in the more southerly States of the Union, it is making a statement which is well within the truth.

## FULL ELECTRIC SERVICE ON THE NEW YORK CENTRAL.

Complete electric service over the zone extending between the Grand Central station and Highbridge on the main line was instituted on April 23, when, for the first time, the Twentieth Century, the Empire State Express, and other noted trains were hauled through the Park Avenue tunnel by electric locomotives. For several months the local and suburban trains of the company have been under electric operation, part of them under the multiple-unit system, and the rest hauled by the new 95-ton locomotives. The change from electric to steam locomotives is made at Highbridge in four or five minutes; but the company expect ultimately to reduce this time to two minutes. The party of officials which went out to Highbridge was treated, incidentally, to a display of the great hauling power of the new equipment, when one of these locomotives picked up a disabled steam locomotive, with its freight train of fifty-six cars, and hauled it to the yard with comparative ease.

## THE PRESIDENT'S INLAND WATERWAYS COMMISSION.

The appointment by President Roosevelt of an Inland Waterways Commission was a step of far greater importance and wider scope than is generally supposed. The Commission is the outcome of the earnest work done by the advocates of improved navigation for the Mississippi Valley, and the work of the Commission will be concerned particularly with inland navigation. This last is a question which is attracting widespread attention in Europe, where there is a marked revival of interest in the question of the rebuilding and development of inland canal systems. It has been suggested by one of our contemporaries that the scope of the Commission should be broadened so as to take in the whole question of the natural water resources of the United States, not merely in its relation to canals, but as it affects all of the many and important interests which depend directly or indirectly upon the natural sources of water supply. Among these may be mentioned, in addition to navigation, the development of water power, the extension of irrigation, the control of floods, and the prevention of the disastrous washing away of surface soil by uncontrolled rainfall. The work of the Commission should include such important questions as that of the conservation of the Adirondack water supply, which is now being made the subject of heated discussion at Albany. Its natural water supply constitutes one of the most valuable assets that a country possesses. The interests affected are so diverse, and in many cases so opposed, that the only satisfactory way to distribute its benefits equitably, and to the highest advantage of the many as against the few, would be to maintain all sources of water supply under State or Federal ownership and control.

## NO BIDS FOR THE NEW SUBWAY.

The figures presented by the Interborough Company in the letter of their chairman, Mr. Shonts, to the Rapid Transit Commission, explaining why they did not put in any bids for the construction and operation of the new subways, will come as a surprise to those people who believe that enormous profits are to be realized from any new subway lines that may be built in this city. The company state that the engineering advisers of the company, including Mr. William Barclay Parsons, who designed, and Mr. John D. Macdonald, who built the existing subways, have estimated that the new East Side subway on Lexington Avenue and the new West Side subway from 42d Street to the Battery, aggregating about thirty-nine miles of single track, would cost for construction and equipment $88,000,000, as compared with a cost of only $71,000,000 for the existing rapid transit lines, which comprise in all sixty-three miles of single track. In other words, the engineer and contractor who built the present subways at a cost of $1,130,000 per mile, estimate that the cost of the new subways, if built according to the present specifications and requirements, would be $2,250,000 per mile.

The reasons given for this increase in cost are, that it is partly due to the requirements of the present law, to the increase in the price of materials and labor, and to the fact that while fourteen miles of the present line is on elevated structure, all of the new line must be built underground. The principal increase in cost, however, is said to be due, first to the onerous provisions of the new contract and plans and specifications, leading to "unnecessary" increase in the cost of construction; second, the adding of the cost of all easements to the cost of the subway; third, the purchase of private property for station entrances; fourth, greatly increased responsibility for damages; fifth, an increase in the diameter of the tunnels; and sixth, the fact that the express and local tracks on Lexington Avenue are upon different levels, an arrangement which adds materially to the cost.

Mr. Shonts's letter states that for these reasons, as above given, if the company were to build the proposed extension in conformity with the Commission's plans, specifications, etc., and using the city's credit for the cost of construction, and assuming that the new lines receive all the traffic which they could carry, it would not be possible to make net earnings above operating and maintenance expenses, sinking fund payments and taxes, sufficient to pay the interest on the city's bonds and five per cent upon the additional capital invested.

The Interborough Company state, however, that they are prepared to build the upper East Side and lower West Side extensions, provided that the cost of construction can be brought within the city's borrowing capacity, and the terms of the contract are such that the company may reasonably expect the earnings from these additional subways to be sufficient to cover the interest and sinking fund upon the bonds of the city issued for their cost; a proper annual charge for depreciation; and interest upon the company's additional investments for which the city's bonds will not be issued.

This means that the Interborough Company are prepared to build the subways if they are permitted to do so in their own way and on their own terms. Hence it looks as though the question must now be faced, as to whether it is advisable for the city to build and operate the new subways with its own money and with its own staff.

## QUARRYING GLACIER ICE.

In Switzerland, since the introduction of electric railways, a new and somewhat strange industry has been established in the Alpine districts, namely, the quarrying of glacier ice for distribution in the large cities. Certain of the Swiss communes or districts have been able to grant concessions of their glaciers for this purpose, and considerable sums have been expended in constructing ice slides or troughs, in which the blocks of ice, many of them being of large size, blasted out of the glacier are transported to the vicinity of the stations for conveyance, in carefully refrigerated vans or cars, to Lyons and other large cities remote from the Alps.

The method of blasting with black powder so as to avoid the discoloration and soiling of the ice, and the ability displayed by the engineers in erecting slides and in providing sufficient friction by means of curves to avoid excessive speed in the downward journey of the ice blocks, show considerable ingenuity and skill.

Glacier ice, which is perfectly pure and transparent, and which has many qualities which are greatly appreciated by the consumers, commands a higher value than that of the usual kind obtained from the lakes and ponds. A singular feature in connection with the preparation of the ice for the market is that it has been found necessary to store it for some days in special warehouses, built like our own ice houses, those with double walls with sawdust between them, in order to remove a coating of frosted or non-transparent ice that tends to form on the surface of the block as it leaves the glacier.

## THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

The eastern and western skies must do their utmost at this time of year to atone for the dullness of the southern. As we face the south, the only conspicuous star before us is Spica, in the constellation of the Virgin. The Crow (Corvus) contains some moderately bright stars, but the Cup, and the tail of the Sea Serpent (Hydra) are by no means prominent. Libra (the Scales) contains two brightish stars. The Centaur and the Scorpion, which are now on the southeastern horizon, are fine constellations, but we never see the best part of the former, and the latter has only begun to show itself, its brightest star, Antares, being just at the point of rising.

Round the zenith are three fine star groups—the Lion on the southwest, the Herdsman (Boötes) on the southeast, and the Great Bear to the north.

Included between these three are the unimportant groups of the Hunting Dogs and Berenice's Hair. Regulus, the principal star of Leo, and Arcturus, which holds the same rank in Boötes, are about equally far from the zenith.

The bright star low in the northeast is Vega in the Lyre. Between this and Arcturus are the semicircle of the Northern Crown and the much larger group of Hercules. Ophiuchus, the Serpent Bearer, entangled with the Serpent which he carries, is coming into sight in the east.

In the west, and pretty low down, we see the Little Dog, with its bright star Procyon, then the Twins, which besides the two bright stars, Castor and Pollux, now enjoy the presence of Jupiter, and, farthest to the right, Auriga, the Charioteer, with the very bright star Capella.

Draco and Ursa Minor are to the right of the Pole, and Cepheus and Cassiopeia below it.

It is interesting to compare the colors of the brightest stars. Procyon, Castor, Regulus, and Spica are all white, and Vega is almost blue. Capella and Pollux are yellow. Arcturus is reddish, and Antares and Alpha Herculis are fiery red.

The reason for these differences had long been conjectured to be that the whitest stars are the hottest, and so on; and this theory is more and more confirmed by observed facts. The spectra of some of the brightest of these stars have been very carefully studied, and (just as in the case of sun spots, mentioned not long ago) it is found that as we pass from Antares to Arcturus, and from the latter to Capella or the sun (whose spectra are very much alike) the same changes take place in the relative intensity of the lines of iron, calcium, etc., in their spectra that happen when we increase the temperature of a terrestrial source in our laboratory. Changes of the same sort, and in the same direction, carry us from the spectrum of the sun to that of Procyon, then to Sirius or Vega, and finally to the bright stars of Orion. It is very probable that these denote a further increase of temperature; but in this case we cannot be quite so sure about it, for it is impossible to get temperatures in our laboratories even as great as that of the sun, and so we have no standards of comparison except uncertain ones in electric sparks, where other influences besides temperature are probably at work.

It is probable that the highest steady heat one can at present produce—namely, that of the electric arc—lies between the temperatures of Antares and Arcturus. The strongest evidence of this is as follows: If we put the metal titanium, or one of its compounds, into an electric arc, the hottest part of the arc shows a spectrum of bright lines, due to the metal, while the outer part of the "flame" of the arc gives bright bands, which are believed to be due to the oxide of the metal, which at the higher temperature of the arc is decomposed into its elements.

Now these bands are very conspicuous in the spectra of such red stars as Antares, but in Arcturus they do not appear, and there is no trace of them in the sun, except in some sun spots. We therefore conclude that the surface of Antares is probably cooler than the arc, and that of Arcturus is as hot or hotter. For other reasons we are sure that the sun surface is much hotter than the arc.

It may be asked, Why then does an arc light look so blue—bluer even than Vega? The answer is that part of the light of an arc lamp comes from the incandescent carbon vapor between the poles, and this is almost entirely blue and violet (showing as splendid bright bands in the spectroscope).

### THE PLANETS.

Mercury is morning star till the 24th, when he passes almost exactly behind the sun, and becomes an evening star. He is visible to the naked eye only during the first few days of the month, in the morning twilight.

Venus is morning star in Pisces, and rises at about 3:30 A. M. in the middle of the month.

Mars is in Sagittarius, very far south. He is approaching opposition and growing more conspicuous. He is twice as bright at the end of May as at the beginning, while his distance from us decreases from 69 to 50 millions of miles. He rises a little before midnight during the early days of the month, and appears a little earlier each evening until on the 30th he comes into sight about 10:30 P. M. It will be another month before he is conveniently observable in the evening.

Jupiter is evening star in Gemini, setting at about 10:30 P. M. in the middle of the month.

Saturn is morning star in Aquarius, and rises at about 2 A. M. on the same date.

He will be a very interesting object, for powerful telescopes, for the earth and sun are on opposite sides of the plane of his rings, and we consequently see the dark side of them. Only the edge is visible, and this only with large instruments, as an exceedingly fine hair line of light.

Uranus is in Sagittarius. On the 1st he is in conjunction with Mars, being 46 sec. of arc north of the latter.

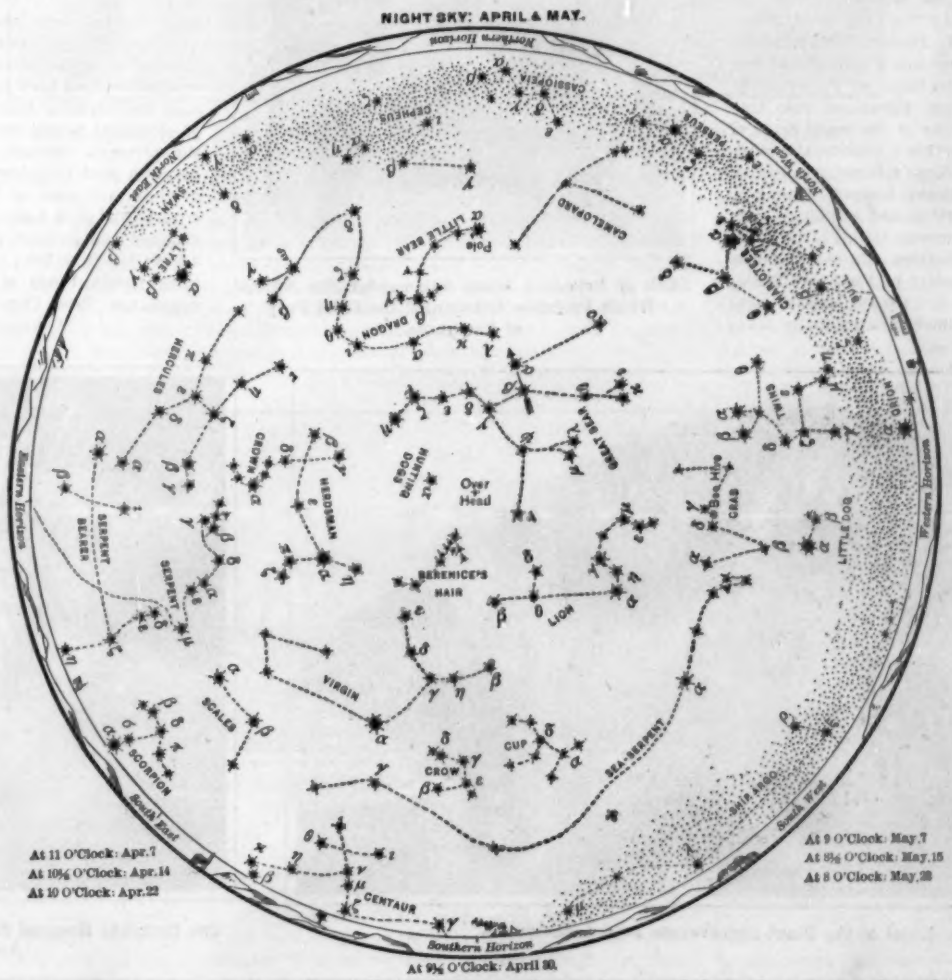
Neptune is in Gemini, close to Jupiter. They are in conjunction on the 21st, Jupiter being exactly one degree north of Neptune.

### THE MOON.

Last quarter occurs at 5 P. M. on the 4th, new moon at 4 A. M. on the 12th, first quarter at 8 A. M. on the 20th, and full moon at 9 A. M. on the 27th. The moon is nearest us on the 28th, and farthest away on the 16th. She is in conjunction with Uranus and Mars on the 2d, Saturn on the 7th, Venus on the 9th, Mercury on the 10th, Jupiter and Neptune on the 16th, with Uranus once more on the 29th, and Mars on the 30th.

A comet, visible in a small telescope, was discovered by Mellish at Madison, Wis., on the evening of April 14. It is in Gemini, moving very speedily northeastward. From this rapid motion it may be assumed that it is now near the earth, but will soon recede from it and grow fainter.

Princeton University Observatory.




In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed; counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

## DEVELOPING PHOTOGRAPHIC PLATES IN DAYLIGHT.

E. Demole, of Paris, brings out some new points as to the reversal of photographic images, and what has a great practical value is his method of developing a plate in daylight. The present researches were made starting with the following well-known facts, first that a sensitive photographic plate submitted to the action of bichromate of potash has the property, when washed and dried, then exposed under a negative, of reproducing this negative by developing in daylight; second, a long exposure changes the latent image, which is then found to be reversed on developing; third, when the sensitive layer is used in connection with oxidizing substances, these facilitate the reversing of the image. The writer proposes to observe the action of the low oxidizing substances on the latent image. When we plunge into a solution of potassium ferricyanide of one per cent strength a plate which has received a luminous impression, rinsing it and then developing it in a bath of hydroquinone and potash, with sulphite of soda, we find two remarkable results. First, that the plate may have been much overexposed without, however, hastening the development nor injuring the plate. The oxidizer acts here as a regulator of the time of exposure. Second, if we develop by the white light of a candle, the plate will be a positive instead of a negative, as would have happened with red light. The reversing of the image takes place even after a very short exposure, but the image is sharper after a long exposure. Such phenomena resemble those of solarization. The same effect can be produced with certain bromide papers, adding five per cent of glacial acetic acid. If the exposure is prolonged beyond a certain limit, the image undergoes a second reversal in the inverse sense. Thus with a Lumière plate exposed under a negative at 18 inches from an arc lamp, one second exposure will give a good positive plate, if we develop by red light. If we prolong the exposure, and then oxidize the plate, we can expose from 1 to 170 seconds and always obtain a reversed plate, that is, a negative. At 180 seconds we first have a positive on developing, but this soon turns to a negative. Using 7 minutes exposure, the positive comes up and then is not modified much, while at 14 minutes exposure the positive is fixed and indestructible, and here we realize the problem of developing by white light which has been so much sought for. If we suppose that the latent photographic image is formed of a sub-bromide of silver, $Ag_2Br$, coming from the decomposition of the bromide by light in presence of gelatine which can absorb the bromine, the sub-bromide of silver, which is a very unstable body, will easily be oxidized and give an oxybromide Ag—O—Br according to the equation $4\ (Ag_2Br) + 4H_2O + 3O_2 = 4\ (Ag—O—Br) + 4\ AgOH + 2H_2O$. This hypothetical oxy-bromide of silver, which is not easily reduced by the sole action of the developer, is more easily reduced by the combined action of the developer and white light, but is less promptly reduced when the surrounding silver bromide has not been altered by oxidation. Then the latent image is stable and the surrounding surface not being so, the image is reversed.

## NAOSAURUS: A FOSSIL WONDER.

BY WALTER L. BEASLEY.

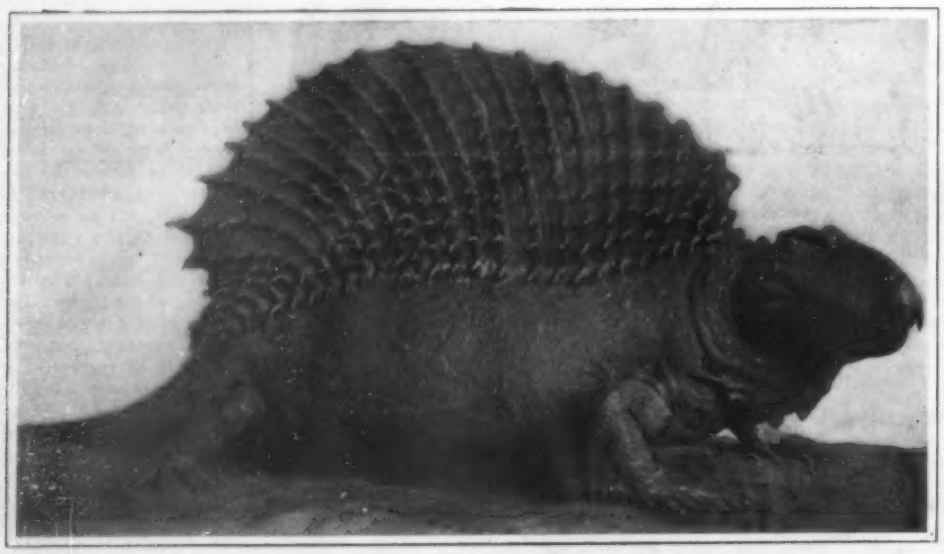
In completing and presenting to public view the first and only complete mounted skeleton in the world of a remarkable fossil wonder, the carnivorous reptile Naosaurus, from the Permian of Texas, Prof. Henry F. Osborn, one of America's foremost paleontologists, and the curator of the Department of Vertebrate Paleontology in the Museum of Natural History, New York, has scored a decided technical achievement, and has likewise made a noteworthy contribution to science. This new and imposing mount forms a valuable and instructive addition to the unequaled display of extinct animal life of the North American continent now to be seen in the halls of the museum, largely the result of sixteen years of systematic explorations in the West, mainly supported by and entirely carried out under Prof. Osborn's personal direction. This ancient Pelicosaurian, hitherto unpictured in full and practically unknown to the outside world, is considered one of the first and oldest land vertebrates that ever trod western America.

The writer, through the courtesy of Prof. Osborn, made a typical series of photographs of the specimen here shown, and presents a popular description of this unique and little-known animal destined to attract widespread attention both in the United States and abroad. The main parts of the skeleton, except the skull and limbs, were found by Mr. Charles H. Sternberg in 1896 on Hog Creek, Baylor County, northwestern Texas. The discoverer was a collector at that time for the late Prof. E. D. Cope, of Philadelphia. The latter, together with Prof. Marsh, of Yale University, made pioneer researches in the fossil fields of the West from 1870 on, recovering a considerable number of extinct forms. Prof. Cope's famous collection containing thousands of specimens, however, from lack of facilities for their preparation and exhibition, was stored in the basement of Memorial Hall, Philadelphia, away from all scientific inspections and sight of public eyes. Through the generosity of President Morris K. Jesup, it was purchased for $50,000, and brought to New York, where the specimens are gradually being mounted for exhibition. One of the rare, choice specimens, and unquestionably about the most curious in appearance and structure of the Cope collection, was the carnivorous reptile Naosaurus, whose marvelous shape was publicly shown for the first time at the recent exhibition of the New York Academy of Sciences, in conjunction with the annual meeting of the American Association for the Advancement of Science. Assembling the composite skeleton, restoring missing portions, and determining the correct and approximate pose, in the utter absence of almost any comparative material as a guide, required the expenditure of much time and the employment of an unusual amount of the most skillful paleontological technique. About the only surviving animal structure bearing a slight resemblance to that of Naosaurus, and to which the latter is remotely related, is the very primitive existing Tuatera lizard (*Sphendon punctatus*) of New Zealand, whose form is of extreme value and interest to the paleontologist, insomuch as it has preserved with very few changes the common ground plan or skeleton framework from which the modern lizards, crocodiles, dinosaurs, and naosaurs have been derived. The latter was an early and very specialized offshoot of this original stem form. An idea of the painstaking and thorough attention bestowed upon the specimen may be gleaned from the fact that Dr. W. D. Matthew, the associate curator, spent three months of critical study in working out a single problem in connection with the assemblage of the skeleton.

Skull of Eryops, a Giant Salamander-like Animal Which Probably Constituted the Chief Prey of Naosaurus.

The difficult points embodied in its final mounting, such as adjusting and setting the many fragile, fragmentary parts, was a fine piece of modern fossil engineering accomplished by Chief Preparator Adam Herman under the direction of Prof. Osborn. By the open or free mounting employed, every bone, etc., can be conveniently removed and replaced without interference with adjoining parts. For the bracing of the delicate elongated spines, a hole was bored from the top clear through each, and a steel wire or rod inserted, which was fastened to the supporting framework. The mechanism of the latter is clearly shown in one of the broadside views here reproduced. The most extraordinary and striking feature of this animal is the series of elongated neural spines, the actual continuation of the vertebral columns, ranging from three inches to nearly a yard in height. Protruding out on each side of these are rows of bony spurs or points, like the cross-yards of a mast, the whole forming a curious armored and elevated fin on the back, spread out like a huge fan from head to tail. In trying to account for some practical use of this puzzling and mysterious appendage, Prof. Cope advanced the hypothesis that

(*Continued on page 370.*)



A Clay Model of the Giant Carnivorous Lizard Naosaurus.

The Complete Mounted Skeleton of the Permian Lizard Naosaurus.

The Head, Showing the Great Battery of Sharp, Tiger-like Teeth.

Mr. Charles R. Knight at Work on the Clay Restoration of the Naosaurus.

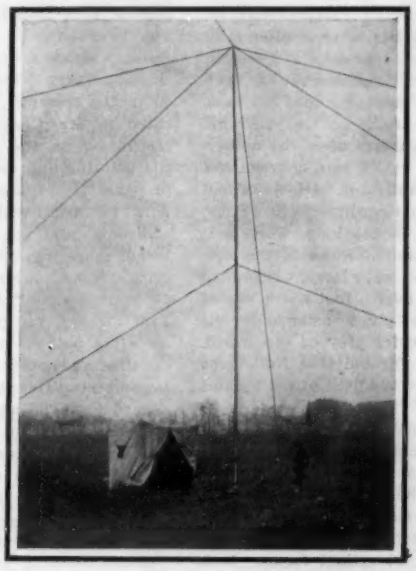
## A MILITARY WIRELESS TELEGRAPH EQUIPMENT.

BY A. FREDERICK COLLINS.

The importance of wireless telegraphy in the game of war has been amply demonstrated in the past, especially in the Russo-Japanese conflict, and as a result of its acknowledged strategic value in military and naval operations, the powers of the world are alert for new suggestions in this regard, and are constantly testing improved methods and systems.

The first attempt to employ wireless telegraphy in actual warfare was made very early in the beginning of the art by Marconi, who at the request of the British War Office designed some special sets of instruments capable of withstanding rough usage for the British-Boer war. It was the intention of the War Office to establish wireless communication between the base of supplies and the railways, but when the inventor's assistants arrived at the scene of action the officers were exceedingly anxious to have the apparatus sent to the front, for it was fully realized that such service would prove exceptionally advantageous, for here was a factor that was wholly unknown to the Boer commanders. The operators and the equipment arrived in South Africa in December, 1899, and were subsequently conveyed to De Aar, where one of the stations was to be temporarily located; but it was soon found that no arrangements had been made to supply the mast, and as the country at that point was quite barren of trees the means for elevating and sustaining the aerial wire was not forthcoming and the whole project was about to be abandoned. Major Baden-Powell saved the day by suggesting the use of kites, and with Capt. Kennedy's aid he constructed a number of these devices and communication was finally established.

The transmission, however, was not wholly successful, for the wind was variable and constantly shifting, and under these conditions it frequently occurred that when there was a dead calm at one station there would be a gale blowing at the other, with the result that the kites could not be flown at either place; on the other hand, on days when the atmospheric conditions were such that the kites could be raised and maintained, messages could be easily sent and received between the De Aar and Orange River stations, a distance of 70 miles. The lessons taught by this experiment stimulated Marconi to design an outfit that would eliminate the troublesome aerial, and this he did by substituting for it a metal cylinder twelve or fifteen feet in height; this cylinder was mounted on top of a petrol-driven automobile and was so arranged that it would lie flat on the roof of the machine when it was being transported across the country. With this form of apparatus and aerial, he was able to transmit messages a distance of about 20 miles.



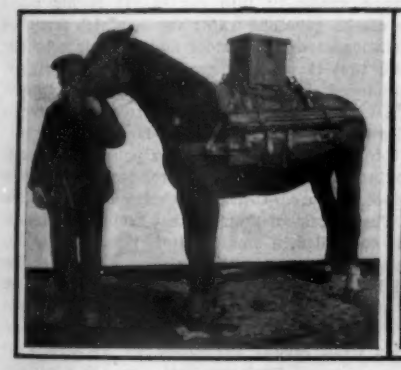
The Complete Field Equipment Installed.

The Sending and Receiving Apparatus.

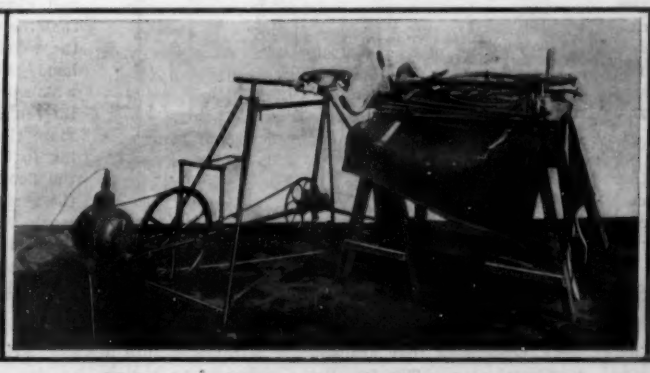
In 1902 the Braun-Siemens & Halske Company designed a wireless telegraph equipment for the German army maneuvers, and this was placed in charge of the Royal Military Airship Battalion. The instruments of this portable military outfit were similar to those of the stationary sets then manufactured by the above company in so far as the transmitter and the receptor were concerned, and these were mounted on regulation gun carriages. The transmitter consisted of a small gasoline engine, belted to a dynamo. The latter supplied the energy for operating the induction coil, and these appliances, together with the accessories, were affixed to one of the gun carriages and formed the transmitting unit. The receptor embraced a coherer, relay, tapper, and Morse register, and these were likewise mounted upon a second gun carriage and formed the receiving unit. The carriages were placed in tandem and drawn by six horses.

A valuable addition to the equipment was a small hydrogen balloon for elevating the aerial wire in calm weather, and this permitted the telegraph to be operated on days when light airs prevailed. The gas for inflating the balloons was compressed in cylinders and carried on the carriage with the receiving apparatus.

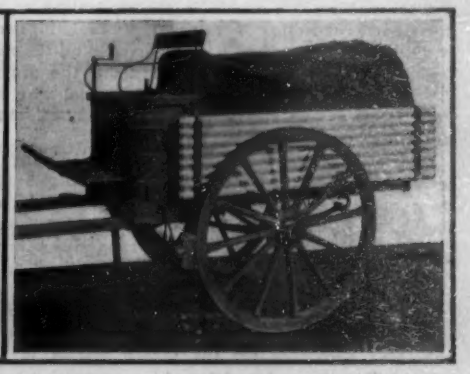
During the trials of this portable apparatus, which were witnessed by the German Emperor, forced marches under the strenuous conditions of actual warfare and hard runs across country at breakneck speed were made. These tests were so successful that a large number of the outfits was purchased by the Russian government and used during its recent war with the Japanese. Since this memorable conflict many changes have been made in the design of wireless telegraph apparatus, and much that was considered good practice then is completely out of date at the present time. One of the requirements for a military set of instruments is that it shall be readily transportable so that it can follow the movements of the troops in the field, and it must furthermore be possible to carry it on the backs of horses or even by the soldiers should occasion arise for such transport.



The Receiver and Accessories Packed Upon a Horse.

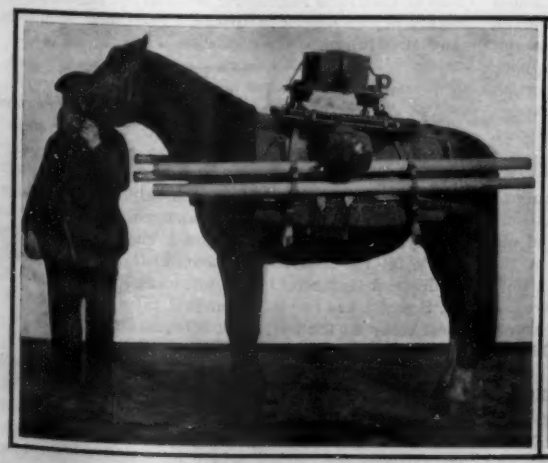


The Pedal Motor Generator Set, Showing the Outfit Ready for Use and Packed for Transport.

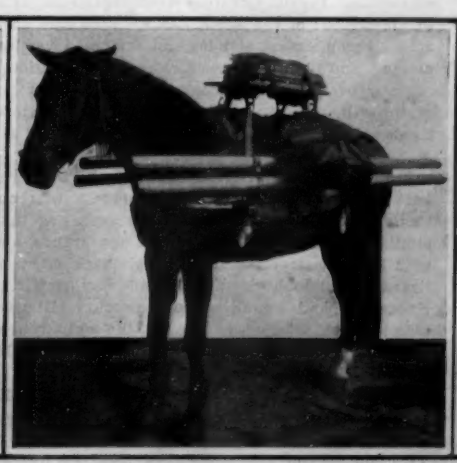


The Apparatus for Two Stations Packed Upon a Cart for Field Service.

While kites and balloons are still used in the army for wireless signaling, both are hardly satisfactory in actual warfare, for the former require almost constant attention, and both, if carried to any considerable height, will expose the position of the troops to the enemy; hence masts are usually preferred if the range to be covered is not too great. Again, gasoline cannot always be obtained for the engine, and consequently another means of generation is desirable.



The Transmitter and Accessories Packed Upon a Horse.



Knockdown Stand and Aerial Wire Equipment Mounted Upon a Pack-Horse.

Pedal Motor Generator Ready for Transport Over Rough Country.

A MILITARY WIRELESS TELEGRAPH EQUIPMENT.

These untoward features led to the design of the sets by the Telefunken Wireless Telegraph Company, of Berlin, in which light, jointed metal masts are used instead of kites and balloons, manually-operated dynamos are employed instead of motor-driven generators, and auto-detectors and telephone receivers are substituted for the old-style coherers and Morse registers.

The new type of portable sets are especially useful for cavalry and infantry scouting service, as well as on the fighting line. The source of energy consists of a small direct-current, shunt-wound dynamo geared to a pedal arrangement and attached to a bicycle frame; it is made up of ten pieces and can be put together in five minutes. One man can easily drive the dynamo at a speed of 1,300 revolutions per minute, when it will develop one ampere at 45 volts. The driving gear and the dynamo complete weigh about 100 pounds.

The transmitter comprises the dynamo with a pilot lamp, the induction coil with its interrupter and condenser, a plug switch, and a Morse key, while the closed oscillation circuit includes the spark-gap, Leyden jar condenser, the secondary of the induction coil, and a tuning inductance coil. Finally, the open oscillation circuit is formed of the aerial wire net, a counterpoise net, or artificial ground, and an extension coil. The weight of the transmitter with its interrupter and condenser is less than 73 pounds.

The receptor includes the aerial wire systems, an oscillation transformer, an adjustable condenser in series, and an electrolytic detector with a fixed condenser in parallel. In the internal circuit there are inserted three choke coils, a head telephone receiver, an adjustable resistance, and three or four dry cells. The conductors leading to the high-frequency circuit are insulated with especial care and are silver plated to reduce the losses by damping to the greatest possible extent. The receptor weighs complete about 22 pounds.

The mast is made of magnalium, is 50 feet in height, and is built up of eight sections each of which is 6.25 feet in length. This carries an aerial wire net formed of six phosphor bronze stranded wires 8.25 feet in length. When set up, the mast is insulated from the earth and serves as a conductor to carry the high-frequency currents to the aerial wire net.

The counterpoise, which is the equivalent of the usual earth connection, is formed of six radiating aerial wires and is attached to a ring surrounding the mast but insulated from it three feet above the ground. The mast weighs 73 pounds and the aerial wire system weighs 110 pounds. The total weight of the equipment is about 440 pounds.

The portable station when set up has a range of over 30 miles across level territory or about 18.5 miles in a mountainous country; the entire apparatus can be packed in a two-wheeled transport cart, if desired, the entire weight of the cart and apparatus being in the neighborhood of 1,900 pounds. This cart is intended to carry the apparatus for both stations to a point where the officers in command have taken up their position and where the first station is to be set up. The apparatus for the second station is then mounted on the pack saddles of horses which advance with the troops. The entire weight carried on each horse does not exceed 110 pounds.

A field staff of seven men is required, an officer, a non-commissioned officer, and five men for erecting the mast and two men to hold the horses. The entire station can be erected in twenty minutes, and then one man is sufficient to operate the transmitter and receptor, while two men are needed alternately to drive the pedal dynamo. Should the infantry use the equipment and the nature of the ground will not permit the apparatus to be moved by horses, bamboo frames are provided from which the heavier parts are suspended, and these are carried by eight men.

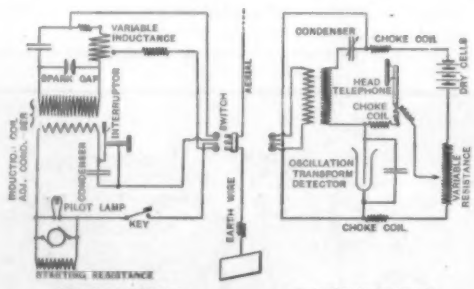



DIAGRAM OF THE WIRELESS APPARATUS.

## NAOSAURUS: A FOSSIL WONDER.

(*Continued from page 368.*)

perhaps the high back crest resembled the branches of some shrubs then growing, and served to conceal the animal in a bushy region, affording a sort of protective covering and hiding place to screen him from sight when pursued by enemies. Then, again, it is thought that the lofty fin may have been employed at times as a sail, whereby the creature navigated the Permian lakes; the latter, however, is not to be taken seriously.

There is absolutely no plausible theory or definite use known for this back elevation; it may have been employed in some manner as a means of defense and protection against the attacks of adversaries, who nearly always pounced upon the back of their victims, or possibly it was an ornament simply. It is believed that Naosaurus was one of the dominant and most formidable monsters of his time. The specimen here pictured was 8½ feet long and nearly 4 feet high. While his habits are not fully known, yet from the structural make-up of the skeleton it is thought he was an awkward, slow-moving creature with a small brain, his actions being chiefly automatic, reflex, with little or no intelligence and cunning. It is probable that the animal could not raise his body far above the ground, and moved or crawled along after the fashion and gait of a crocodile. The tall spines were most likely covered with muscle or membrane. The feet were supplied with sharp claws, two inches long. The head was enormously large in proportion to the body. The legs and neck were short, the tail exceptionally so, being 2½ feet long. The hind feet were smaller than the fore feet which is just the opposite of the case in modern lizards. The eyes were large and set far back near the top of the head. In foraging for food the rapacious lizard was not a vegetarian, but satisfied his appetite and waged constant warfare upon the numerous animals of his day, which varied in size from that of a salamander to a Florida alligator. His jaws had an extensive battery of sharp tiger-like teeth. Some of the front tusks, nearly 3 inches long, were well adapted for his flesh-eating habits. Some of the contemporary animals, like Eryops, were large, with broad flat heads, 20 inches long and over a foot wide; one of these is here shown. This giant salamander is thought to have formed the chief prey of the lizard. The sharp tooth mechanism indicated that Naosaurus probably tore off and swallowed the flesh of his victims whole without chewing.

Prof. Osborn, in a forthcoming Museum Bulletin, devoted to a preliminary technical description of the present skeleton, says: "The reader will, therefore, thoroughly understand that the assemblage is largely composite. It serves, nevertheless, to give us for the first time an adequate conception of the unique and imposing characters of these great extinct forms. It is probable that Naosaurus was a somewhat more robust animal, but otherwise much like Dimetrodon. The limbs and feet used in this assemblage may fairly represent Naosaurus, but more probably belong to a large species of Dimetrodon. We are struck by the enormous and powerful head, which was supported by ligaments attached to the stout neural spines of the anterior cervical dorsals; the elongated back, from which radiate like the rays of a fan the greatly elongated neural spines, the transverse bars of which suggested the name Naosaurus or 'ship lizard' to Prof. Cope. Anteriorly the spines almost overhang the back of the head, posteriorly they are sharply retroverted into a horizontal plane. The fore limbs supported by a very powerful shoulder girdle, with relatively large and more powerful hind limbs. The horizontal position of the humerus and femur and the sharp angulation of the ankle joints are conditioned by the peculiar position of the articular facets. The pose is taken from a careful study of some of the existing lizards. The skull is modeled from a comparative study of several Pelicosaur skulls in the American Museum, with the assistance of one loaned by Prof. S. W. Williston from the University of Chicago. It is probably substantially correct. The neural spines of the anterior dorsals are directed upward, and partly expand at the extremities to support the stout ligaments attached to the occiput of the skull. As we pass backward the spines become more slender and assume a vertical, an oblique, and finally a curved retroverted position, horizontally overhanging the sacrum and anterior portion of the tail. The vertebral formula is approximately: Rib-bearing cervicals, 5; rib-bearing dorsals, 19; sacrals, 5; caudals, 25."

For want of a better descriptive word the term "fin back" has been employed to designate this animal, though in a somewhat misleading sense, as the only similarity to a fish's fin is one of appearance, and not at all in construction. This high back crest in the lizard was undoubtedly a rigid and bony growth. Both Naosaurus and its allied contemporary, Dimetrodon, stand out absolutely unique as the only representatives of the whole animal world possessing this astonishing and immense growth of the spines.

In estimating the age of this creature according to geological reckoning, figuring the Permian epoch as half of the Age of Amphibions, viz., 2,500,000 years, 7,000,000 for the Age of Reptiles, 3,000,000 for the Age of Mammals (the 50,000 years of the Age of Man being negligible), it is probable that Naosaurus trod the primeval lands and roamed around the shores of the great Permian lakes of Texas about 12,000,000 years ago. This animal therefore flourished millions of years before the huge dinosaurs like Brontosaurus and others became dominant in the Age of Reptiles, being twice as old as the latter, and five times older than Eohippus, the little catlike four-toed horse of the Lower Eocene Age of Mammals. The Wichita Red beds of northwest Texas, in which the ancient remains of this land vertebrate were found, attain a thickness of 2,000 feet. The Permian beds are said to extend for 600 miles across Kansas, Oklahoma, Indian Territory, New Mexico, and Texas. The reader's special attention is called to the splendid and ideal front page drawing, executed by Mr. Charles R. Knight, who is universally recognized as the leading artist in this country in the painting and modeling of extinct animal life. The probable life appearance of this remarkable animal, with its high, sail-like fin or armored crest, characteristic pose, etc., is strikingly portrayed. The external shape was completed only after very careful and critical examination of the skeleton and its structure, as well as other related forms, under the direction of Prof. Osborn, and consequently is based upon accurate scientific points. Both the painting and clay model of this and other animals, however, represent the present state of paleontological knowledge known in regard to them, and are subject to modifications and changes by future discoveries. The writer acknowledges his indebtedness to Prof. Henry F. Osborn for special courtesies extended in obtaining illustrations and material for this article.

### Is There Water on the Moon?

Some striking photographs made by Prof. W. H. Pickering of the volcanoes in the Hawaiian Islands serve to point out certain characteristics which they have in common with the craters on the moon. One photograph of a long crack, extending some miles, in the lava crust at Hawaii serves to emphasize Prof. Pickering's belief that water or water vapor exists on the moon, and by irrigating cracks on the moon's surface gives rise to vegetation in them, just as trees and shrubs have sprung up in the Hawaiian lava crack. In studying Erastothenes in 1904, Prof. Pickering found its interior seamed with numerous fine cracks. Watching some of these cracks soon after the sun arose on them he was able to see them broaden out and change gradually into canals. It is his belief that the cracks gave out water vapor, which fertilized the vegetation along their sides and in their neighborhood, and that it was the growth of this vegetation which produced the appearance of a canal. A further inference is that the canals on Mars, which become more clearly visible at some periods of the year, owing to the melting of the Martian polar ice cap and the flooding of the waterways, are similar cracks on the surface of Mars. Cracks of the kind occur on the moon. The largest of them is that known as Sirsalis, which is 400 miles in length. It is possible also that they exist on the earth, though they are not readily discernible. It has sometimes been supposed that terrestrial volcanoes lie along subterranean cracks.

### Fritz Gold Medal Presented to Alexander Graham Bell.

In the course of the exercises which marked the formal opening of the building of the United Engineering Society, the John Fritz gold medal was presented to Alexander Graham Bell, for the invention and introduction of the telephone. This is the third medal of the kind awarded. The first was given to Lord Kelvin for his work in cable laying and the second to George Westinghouse for perfecting the air brake. Mr. Bell will depart for England in a few days and will receive the degree of doctor of science from the University of Oxford. Commemorative medals were given to R. W. Pope, secretary of the American Institute of Electrical Engineers; Rossiter W. Raymond, secretary of the American Institute of Mining Engineers, and Mr. Hutton.

### Prizes for Safety Devices.

The American Institute of Social Service announces that in addition to the Scientific American medal, Francis H. Richards has offered a gold medal to be awarded annually by the Institute for the best invention for safeguarding life, to be exhibited at the museum relating to automobiles and motor boats, also an anonymous gift of $5,000 from a city outside of New York, for the American Museum of Safety Devices and Industrial Hygiene. It was announced also that Dr. L. L. Seaman has offered an annual prize of $100 for the best essay on the subject of safeguarding life.

The growing popularity of interlocking rubber tiling is shown by its invasion of new fields, being extensively used in kitchens, vestibules, and bathrooms of the better sort; in fine ocean liners, lake steamers, ferryboats, and yachts, where its non-slippery character and the fact that it remains unaffected by constant wrenching strains render it very valuable, and now it may be seen in one of the finest cathedrals in the country and in one of the largest of our public art galleries.

# Correspondence.

### Erosion Due to Expanding Wall of Gun.

To the Editor of the SCIENTIFIC AMERICAN:

The writer notices a new theory of gun erosion in your issue of April 13, 1907. Judging from the experience the writer had early in the history of automobiles, we are very positive that the new theory is right. The writer conceived the idea of using light drawn-steel shells for cylinders, and constructed several automobile engines on that principle. Both theoretically and mechanically they appeared all right, but we were unable to get the power from the engines that we thought they should develop. The pistons would show perfectly tight on the compression stroke, and everything would apparently be all right, but under the high pressure of the burning charge we found that *the walls would expand sufficiently to allow the gas to escape*, and we therefore had to abandon the light drawn-steel construction on account of its elasticity.

Pontiac, Mich., April 16, 1907. A. R. WELCH.

### The Influence of Seasons on Earthquakes.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to an item in the SCIENTIFIC AMERICAN of October 6, 1906, entitled "The Alleged Influence of the Seasons Upon Earthquakes," I beg leave to supplement the explanation of Mons. de Ballore with a thought which does not seem to have occurred to him, and which, I believe, would account for a very large percentage of the "earthquakes" reported during the cold season from northern latitudes; viz., that these are not earthquakes at all, but are due to:

1. The freezing and cracking of the ground.
2. The cracking of the ice in large bodies of water.
3. The grinding of ice floes, where such are found, as here on Bering Sea.

I believe that these three causes will explain nearly all of the alleged earthquakes reported from Alaska. I know that they will explain *all* of those reported from Nome and the surrounding country in the last seven years. CHARLES W. THORNTON.

Solomon, Alaska, January 3, 1907.

### Coffee Filter.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 23 there is an illustration of a recent patent, which goes to show how history repeats itself. Fifty-eight years ago I was using in my first housekeeping, in the western part of New York State, a precisely similar coffee filter, which I saw in common use among my neighbors, from whom I copied it. A coarse muslin bag contained the ground coffee, through which the boiling water was poured, as it hung in the coffee pot. In the heavy muslin hem finishing the top of the bag, four open buttonholes were worked at the four quarters of the bag. Through these two No. 10 wire rods about five inches long—bent round to a ring at one end, for hanging up with the bag, when washed, to dry—were put crosswise and holding the bag in the coffee pot, just as the patentee's legs and rings inside do. It was very effective and simple, and we used it many years; yet it required considerable care and work. So when Marion Harland's patented coffee pot with perforated tin strainer came on the market, we used that.

While I am writing, permit me to add a most earnest protest against the article I notice in your Notes and Queries department of March 30. A correspondent N. L. in Query 10,485 most impertinently accuses you not only of error in your answer to him, and general childish ignorance, but also trying to cast ridicule on your correspondent, "as you frequently do," he writes.

I have been an almost constant reader and subscriber of the SCIENTIFIC AMERICAN for fifty-four years, and I have never seen anything but the most patient courtesy in that interesting department. I have wondered again and again at the patient outlay of time and labor over sometimes the most puerile questions propounded. Instead of "casting ridicule" on your correspondent, you have often and again taken pains to open their eyes to self-evident absurdities without expostulation for the waste of room. As one competent judge (as far as time and attention are concerned) I express my sincere regret that you should be so ungratefully treated. R. WHITTINGHAM.

Aikin, Md.

### Snowshoes for Wagons.

To the Editor of the SCIENTIFIC AMERICAN:

I am one of your readers for the last ten or twelve years, and I have read almost everything in your valuable paper ever since.

Having to travel much this winter, I could not follow the reading of your paper regularly, and to-day in reading the back number of January 19, 1907, your article on "Snowshoes for Wagons" attracted my sight, and I cannot pass over it without a few comments.

These shoes are not new at all in this part of the Province of Quebec. To see snowshoes being used and put under wheels is common enough, chiefly at this time of the year, when the snow comes and goes again every other day.

If I am not mistaken, these shoes were used first by the firm of C. Rouleau & Fils, coal and wood dealers, and L. P. Morin & Fils, general contractors and manufacturers, some eighteen or twenty years ago. Later on the fire department of our city used them under the wheels of one of our fire engines, and they were taken out only a few days ago on account of the roads being too bad for sleighing. I wish it was not too late, I would send you a photograph of the engine on its shoes, also one of the other shoes as used elsewhere in town.

The first originators have not applied for patents, but have let everyone make use of their process.

It may be that the snowshoes were used before in other parts of the province, but I am not aware of it.

Mr. C. Rouleau is also the first person in this city to have used under his coal carts a snow skate arranged with a hub in such a way that the wheels can be taken away from the cart and replaced by the skates in less than five minutes, and the only tool necessary for the operation is a monkey wrench. These skates are now in use everywhere in the province, chiefly in the towns.

The snowshoes shown in the January number are similar to those used in this city. J. C. ROULEAU.

St. Hyacinthe, Quebec, April 13, 1907.

### The Mosquito Problem.

At the annual meeting and dinner of the American Mosquito Extermination Society, held at the Union League Club in this city on April 19, several interesting facts were given concerning the progress made within the past two or three years in the ways and methods of preventing the production of mosquitoes. The guest of the evening was Dr. L. O. Howard, chief of the Entomological Division of the Agricultural Department at Washington. He spoke of the anti-mosquito movement as one of world-wide interest and importance. In the English tropical colonies the drainage of marshes and other similar locations had been undertaken on a large scale at a comparatively reasonable cost with remarkably good results. Under government supervision the abolition of malaria and mosquitoes from Klang and Port Swettenham in Silangor, Confederated Malay States, had been effected with the small expenditure of $1,200 for Klang and $700 for Port Swettenham. A much smaller sum sufficed annually to maintain mosquito prevention.

The admirable work done at Ismailia under the auspices of the Suez Canal Company was alluded to. He described the great movement just inaugurated by the Lake Kopais Company and the Anti-Malaria League of Greece to eliminate the malaria so common in that country to the detriment of its economic force. He believed in the United States, mosquito-breeding districts could be easily improved; it was but a question of funds and an enlightened public spirit.

Another gentleman described the method of improving the marshes on the south side of Long Island. It has been found that the movement of the tidal waters through the creeks and small waterways and over the meadows prevents the generation of the mosquito; but if the water is caught and held stationary in any depression or pothole on the meadow, then a place is formed for their rapid production.

In this instance the plan was adopted of draining by running small ditches from these depressions to some regular creek or outlet. It was done at a very reasonable expense, and avoided the necessity of making many large ditches. There were about seventy-five miles of salt marshes along the ocean front, which if well drained would stop the annual visit of the mosquito. Some twelve or more square miles of meadow in the vicinity of Jamaica Bay and east of that place had been thus drained, and each summer a noticeable decrease in the quantity of mosquitoes was evident. His contention was that small sections of the meadows could be drained each year until large areas would ultimately become non-productive of the insects.

Prof. D. L. Van Dine, Government Entomologist of Hawaii, happening to be here, was present and referred to the work of mosquito prevention at Honolulu, the interest the authorities took in it, and the methods employed to rid the island of the pest. He stated before the work of prevention was begun, it was impossible for one to secure a good night's rest, his first night there being one of torment indescribable. Through the aid of local appropriations, the work of drainage was begun in a moderate way, and means were taken to treat with oil, pools and other places until the city was reasonably free from mosquitoes. One year the work was held up for lack of appropriations, resulting in an additional increase in the presence of the pest. The yellow fever mosquito, *Stegomyia*, was a species present in Hawaii, brought there many years ago by a whaler. The fever, however, does not obtain a foothold because the sailing time to the islands is so great that the fever-infected persons either die or recover before the vessel arrives in port.

There is some fear that when the Panama Canal route is opened, the sailing time will be so greatly shortened as to make the danger of introduction of the fever into Hawaii greater; hence there is great urgency of again ridding the islands of all the pests. The Health Department had five hundred mosquito-larva-eating minnow fishes transported from the United States to Hawaii, and four hundred lived. These have been of great value in checking mosquito production, multiplying into the millions.

The work accomplished in draining the meadows and marshes on the southern end of Staten Island, N. Y., under direction of Dr. Doty, Health Officer of the Port, was described by Mr. Walter C. Kerr. It was found there was very much less annoyance from the mosquito in the summer of 1906 than in previous years.

Mr. Spencer Miller, of Orange, N. J., spoke of the great drainage work that had been completed on the Newark Meadows under the New Jersey mosquito prevention State aid law. The expense averages only about two dollars an acre. The freedom from mosquitoes in Newark and the Oranges was very noticeable in the summer of 1906. The State Legislature appropriated $350,000 toward meadow drainage on the installment plan. If a town situated in the mosquito district or zone appropriated a certain sum, the State advanced to the town an equal amount. In this way the cost of drainage to each adjacent town or city was much reduced.

Dr. E. Porter Felt, the New York State Entomologist, spoke of the necessity of the careful study of the fifty species or more of mosquitoes that abound in the State, to determine the best method of controlling the production of those which convey infection of fever and other diseases to the human body. Biological investigations had disclosed the fact that intestinal troubles were produced from a mosquito bite. But little investigation had been undertaken in the Adirondack section of the State, where mosquitoes are found in vast quantities. A comprehensive study of all the mosquitoes in the State should be made, since the findings would have a most important effect in stimulating local interest and activity, and particularly in assisting real estate values.

### A Dangerous Flywheel Explosion.

At midnight on the night of March 24, 1907, there occurred a disastrous flywheel explosion at the power house of the Philadelphia Electric Company, at 213 Susquehanna Avenue, Philadelphia, Pa. It was occasioned by the breaking of a 40-inch belt while the engine was pulling a heavy load.

The sudden releasing of the load caused the engine, which was a 900-horse-power twin Corliss, to jump suddenly beyond the control of the governors. Before it was possible to close the throttle the great 10-ton flywheel had speeded up to the bursting point.

The wheel was 20 feet in diameter with a 4-foot face and built in eight sections. The steam pipe was severed by a piece of the flying rim, thus releasing the steam from about thirty boilers, with about 170 pounds pressure on them, and completely fogging the engine room with hot vapor. About this time the lights all went out, leaving the place in total darkness. Very fortunately no lives were lost, though there were several very narrow escapes. One large fragment of the wheel was thrown vertically through the ceiling and roof, making a hole about twenty feet in diameter and coming down through the roof of the boiler room. Another piece took a pilgrimage across the street through the front of a house and clear out the back. It required five men to carry it back. Still another, on its return from the upper air, entered the roof of a three-story house and, narrowly missing the sleeping occupants, came to rest on the second floor.

It is to be hoped that the day of glued belts, involving danger to life and property, is hastening toward a close. The direct-connected reciprocating engine, or, better yet, the steam turbine, for the generation of electricity on a large scale will obviate the danger of flywheel explosions from breaking belts.

### The Current Supplement.

The English correspondent of the SCIENTIFIC AMERICAN opens the current SUPPLEMENT, No. 1635, with an article on the tin-mining industry of Cornwall. Excellent illustrations accompany his article. Prof. C. E. Lucke and S. M. Woodward's paper on the use of alcohol and gasoline in farm engines is concluded. An article on petroleum and its refinement gives much helpful information on a great industry. Dr. Wendell Reber discusses illumination as affecting the eye. "Photographing Lightning with a Moving Camera" is the title of a study of lightning flashes which is illustrated by actual photographs.

### THE FELLING OF FACTORY STACKS.

BY OUR BERLIN CORRESPONDENT.

In connection with a contemplated extension of the plant of a boiler house, the central workshops of the Munich Central Railway Station recently intrusted Joseph Houzer with the erection of a new steam stack 164 feet in height, to be located between two existing stacks 105 feet in height, which latter thus became superfluous.

Mr. Houzer suggested, instead of dismounting these stacks, to fell them in bulk. This plan was adopted. The first stack was pulled down before the construction of the new one had been commenced, while the other was reserved until the new stack was completed.

The main difficulty encountered was to accurately fix the falling direction of the two stacks in a west-eastern line, and *vice versa*, the stacks being encircled both to the right and left by a closely crowded group of workshop buildings. The second stack was situated immediately in front of the new one.

The first operation consisted in carefully dismounting the base masonry in the direction of falling to about 2½ feet height, replacing it by convenient props. The props then were surrounded with kindling wood and oil-soaked rags. Kerosene was poured over this and ignited. The props burnt away rapidly. The mammoth stack, bending sideways, fell to the ground exactly in the prescribed direction. At this moment a huge cloud of dust and soot momentarily hid the stack from the numerous spectators. By far the greater part of the bricks were undamaged and even cleaned by atmospheric pressure.

As both stacks were situated in the immediate neighborhood of the boiler house, the use of explosives was quite out of the question.

The operation was carried out without any hitch, and in a minimum of time, viz., in the case of the second stack in four minutes from the lighting of the wood until the moment of falling.

Fig. 1.—Just Before the Fire Was Lighted.

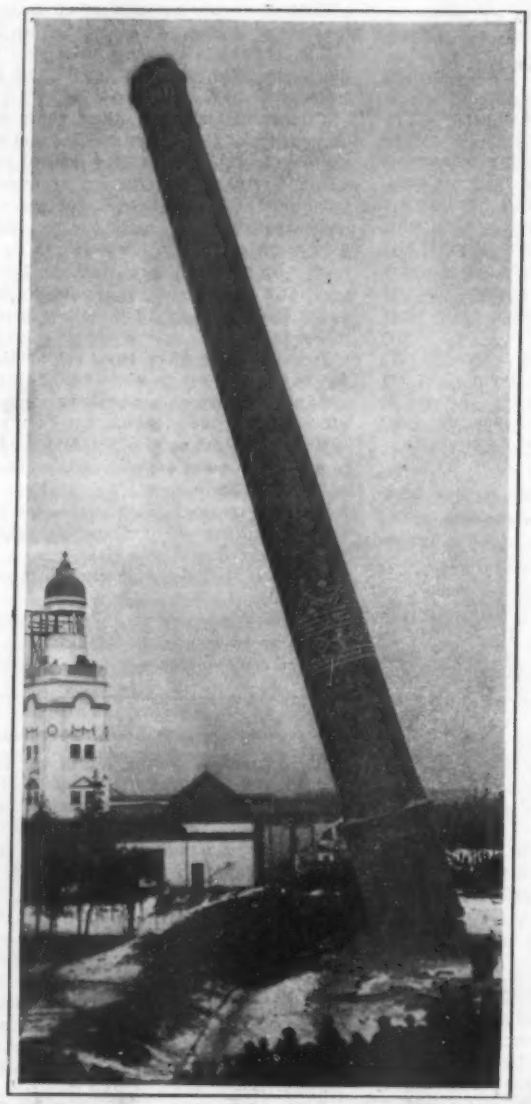


Fig. 2.—After the Props Burnt Away the Stack Toppled.

### A New Theory of the Origin of Earthquakes Developed by Prof. T. J. J. See.

The Proceedings of the American Philosophical Society at Philadelphia, March, 1907, contain an exhaustive investigation on earthquakes by Prof. T. J. J. See, U. S. N. The paper is 140 pages in length, and the subject is treated in the most comprehensive manner. Prof. See is in charge of the Naval Observatory at Mare Island, Cal., and was thus in the midst of the great earthquake which destroyed San Francisco. As the outcome of his studies he shows that earthquakes of the world-shaking class are caused by the explosion of lava from beneath the bed of the sea, by the explosive power of steam which develops beneath the earth's crust by the secular leakage of the ocean bottom. He shows that the pressure of the deep sea upon the bed of the ocean is so great that water is driven down through the rocks of the earth's crust, and at a depth of fifteen or twenty miles it comes into contact with molten rock at a temperature of about 2,000 deg. Steam is thus formed beneath the crust, and it finally acquires such power that the rocks are shaken, and lava expelled from beneath the sea toward the land.

One of the most remarkable results of Prof. See's researches is the development of a new theory of mountain formation.

It has been customary for about eighty years to explain the mountains by the supposed shrinkage of the earth. Now comes the new theory of the earthquake work, and it proves that mountains, too, are formed by the sea; when lava is expelled from beneath the sea by earthquakes, the crust is broken and pushed up along the seacoast. All the region is injected with porous lava or pumice. It lies under all mountains, and is blown out of those mountains which break into eruption and become volcanoes. Earthquakes and volcanoes are thus directly connected, as the ancients believed; but as a general rule the steam-saturated lava does not escape to the surface, but remains hidden in the earth. It is only occasionally that the steam breaks out and forms volcanoes.

But Prof. See has not only explained earthquakes and mountain formation along the seacoast; he has also explained the formation of islands in the sea, the feeble attraction of mountains long noticed in geodesy (they are found to affect the plumb line as if they were hollow), and how the great seawaves are produced which frequently accompany violent earthquakes, and sometimes do more damage than the earthquakes themselves.

By a thorough study of earthquakes the writer has explained half a dozen classes of phenomena by a single cause, which is proved by elaborate and exhaustive argument. If these results are confirmed, there are many who believe that no generalizations since Newton's discovery of gravitation in 1687 will have more far-reaching effects upon all the sciences which deal with the earth.

Prof. See has given public lectures on the subject at the University of California, and it is said that the greatest interest has been aroused there. The Seismological Society of America has been organized, with Prof. Davidson as president and Prof. See as one of the vice-presidents. It is reported that he had just finished his mathematical researches on the physical constitution of the sun and planets when the earthquake occurred, and it became necessary to come down to the study of the phenomena of the earth.

The earthquakes in Valparaiso and Kingston illustrate the new theory, and show that steam within the earth is the cause. All great earthquakes occur along the seacoast or on islands in the sea.

Fig. 3.—As It Fell the Stack Slid From Its Pedestal and Broke Into Several Parts.

THE FELLING OF FACTORY STACKS.

The most significant tendency which an observer of educational progress sees to-day is that of specialization. The time is fast approaching when it will be recognized that merely a general education, whether on classical or scientific lines, is not alone a suitable preparation for life. Not that culture is less desirable than formerly, rather it is more desirable, but above this general substructure must be placed a technical education which will give that special application to some calling which the coming age will demand. Colleges which devote their attention solely to general cultural training will become of less importance. The institutions now known by the various titles of technical colleges, institutes of technology, and polytechnic institutes, are the colleges of the twentieth century which will do most for their students, which will be in closest touch with the needs of civilization, which will provide at once the most cultural, the most rational, and the most scientific instruction. These institutions, by whatsoever name designated, will be the important colleges of the future, because they will give that perfect unity of thought and action, that harmony of theory and practice, which the needs of the future demand.

## THE JAPANESE SQUADRON AT JAMESTOWN.

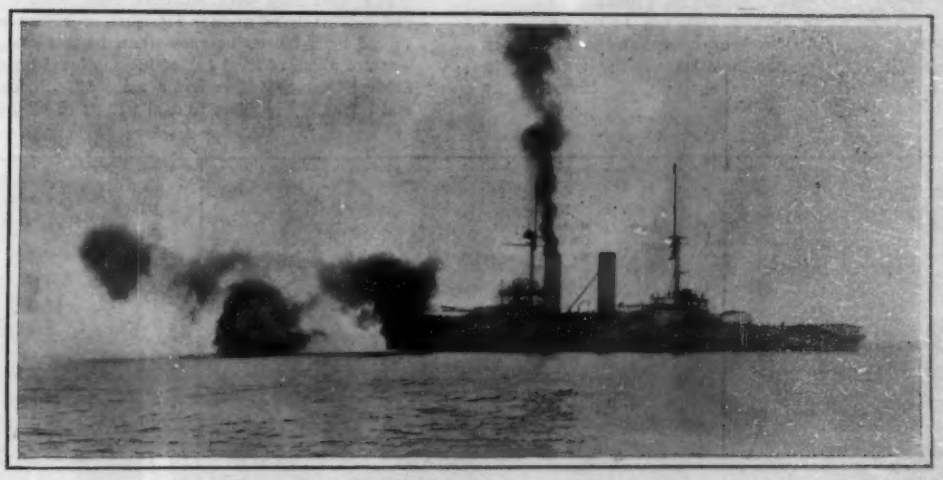
BY SAITO TSUNETARO, IMPERIAL FISHERIES INSTITUTE, TOKIO, JAPAN.

The Japanese squadron, consisting of the first-class armored cruiser "Tsukuba" and the second-class cruiser "Chitose," left Yokohama on March 28th at 11:30 A. M., amid a splendid send-off, for the United States to attend the international naval and military celebration to be held at Hampton Roads. These two ships of the Imperial Japanese navy will not be unworthy to take their places among the many warships which will be sent out by various civilized nations to participate in the celebration.

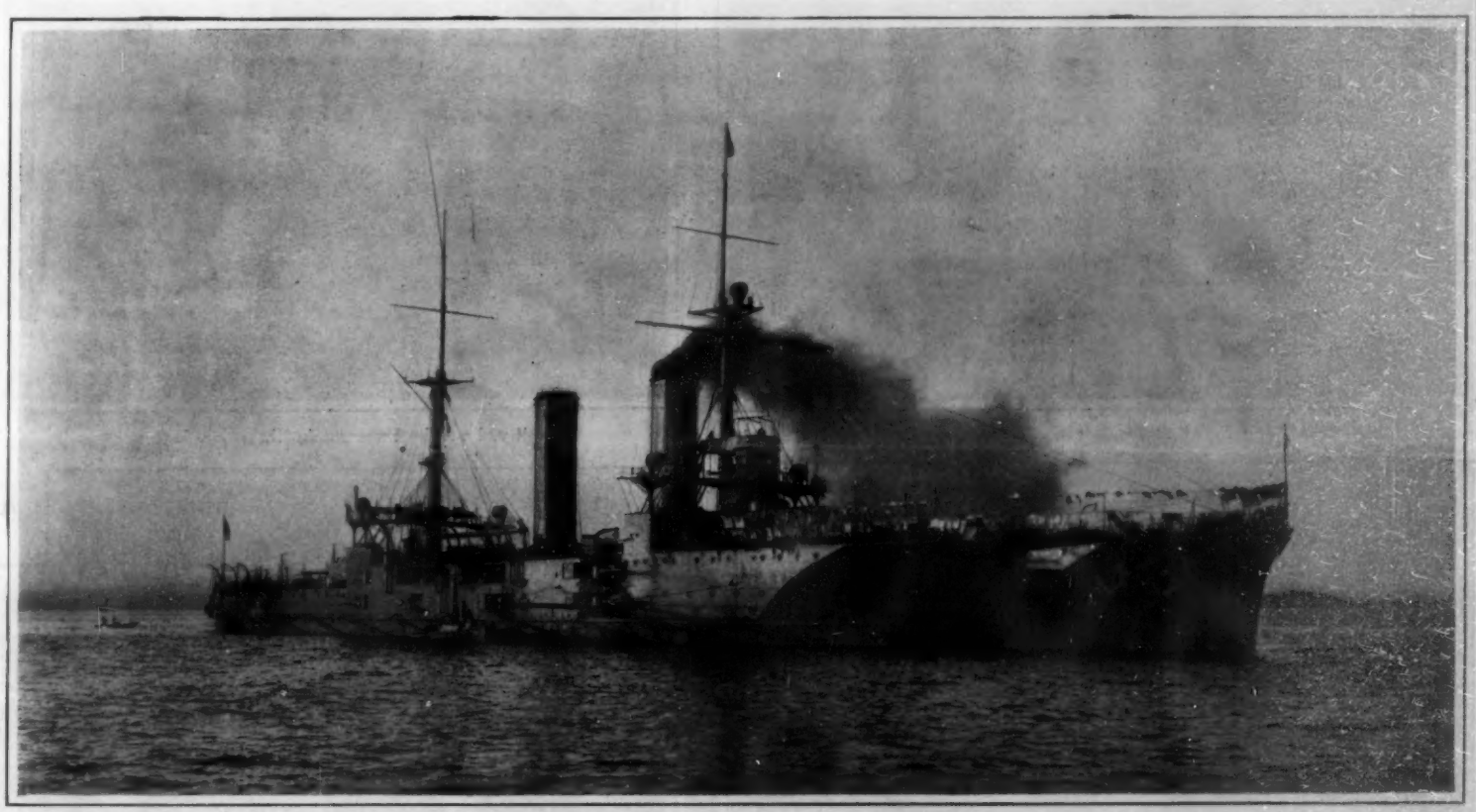
That the "Chitose," built in America ten years ago and on that account historically associated with the great republic, did splendid service during the Russo-Japanese war, is well known to the readers of the naval history of that conflict. She belonged almost continually to the Third Division under Admiral Dewa during the war and took part in every important engagement. The cruiser commanded by Capt. Takagi was the flagship of the above admiral when the first attack was delivered on Port Arthur in the beginning of February, 1904, and remained so for a considerable time thereafter, H. I. H. Commander Prince Higashi Fushimi being her executive officer. Besides participating in the memorable battle of August 8, when Admiral Vithoft with the whole fleet under his command made a bold attempt to break through the blockade of Port Arthur, she played a conspicuous part in the enveloping movements in the battle of the Sea of Japan and contributed to the demoralization and destruction of the enemy's cruisers and special service ships. On the second day of the battle, while the ship was steaming alone toward the Liancourt Rocks, she encountered a Russian destroyer, afterward known to have been the "Bezpretchny," and instantly sent her to the bottom. It was the "Chitose" that after the battle of August 10, advancing to Korsakoff (then a Russian port) in Saghalien gave the *coup de grâce* to the "Novik," the quickest cruiser afloat at that time, which had been very active during the siege of Port Arthur.

The Japanese nation is gratified that the "Tsukuba" was selected with the "Chitose" to represent the Japanese navy at Jamestown, as the former is the newest and largest home-made warship so far completed, being the best specimen of Japanese naval construction to be exhibited before the world. The "Tsukuba," whose keel was laid in January, 1905, was launched in December of the same year; and her equipment having been completed on February 10, she was delivered by the Kure navy yard authorities to her present commander, Capt. Takenouchi, on February 14 last in order that she might take her place as a unit of the Second Squadron. This armored cruiser is 440 feet in length, 75 feet in beam, of 13,750 tons displacement, and about 20,000 horse-power. Her armor belt of Krupp steel ranges from 4 to 7 inches and her intended speed was 20 knots, but she made about 21 knots in her speed trial. The most conspicuous person in connection with the construction of the "Tsukuba" is Vice-Admiral Yamanouchi, who personally superintended it and whose great technical knowledge combined with rare administrative ability has made the Kure naval arsenal what it now is. As her construction was commenced after about a year's experience of modern naval warfare, it is known that she embodies a number of valuable lessons derived therefrom. In appearance the big cruiser marks a striking departure. Not only has the ram, with which we have so long been familiar, been omitted, as is the case with the "Satsuma," but she has a "schooner bow." Thus the cruiser has been especially strengthened forward and the overhang of the bow to the cut-water is expected to keep the fore part of the ship comparatively dry in a heavy sea. The fourteen ventilators of the ship being very low are invisible from outside and little exposed to the enemy's fire. They are also different in construction and shape from those of most other warships. Among other de-

(*Continued on page 377.*)



GUN TRIALS OF THE "TSUKUBA" AS SEEN FROM OFF THE PORT BEAM.



**Length,** 440 feet; **Beam,** 75 feet; **Displacement,** 13,750 tons; **Speed,** 21 knots; **Armor:** Belt, 7 inches; **Turrets,** 9 inches; **Guns:** four 45-caliber 12-inch; twelve 6-inch; twelve 4.7-inch; two 3-inch; four Maxims. **Keel laid** at Kure, Japan, January, 1905; launched, December, 1905; commissioned January 14, 1907.

THE JAPANESE CRUISER-BATTLESHIP "TSUKUBA"—A NEW TYPE OF WARSHIP.

STERN VIEW OF THE 'TSUKUBA" DURING HER GUN TRIALS.

## THE COLORADO RIVER CLOSURE.

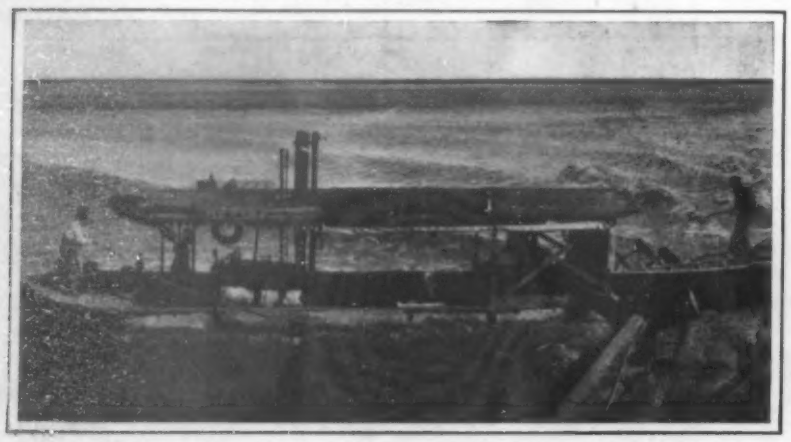
BY W. D. H. WASHINGTON, ASSOC. MEM. AM. SOC. C.E.

After numerous fruitless trials, and a temporary stay, decision seems to have been finally rendered, in the case of the People vs. the Colorado River, in the celebrated Salton Sea matter.

Few questions have attracted such wide attention, and seldom have greater interests or values been involved by a river's overflow than in this case, which was not alone of local but of international importance. Seldom have engineers had a more difficult, obstinate, and refractory problem to deal with, and seldom has a greater victory been won over rebellious nature; in proof of which, let the facts be noted: First, that the statistician of the U. S. Reclamation Service has in a recently published article estimated the amount of damage that might be done, in case this break of the Colorado were not stopped, would eventually approxi-

Trestle Over Hind Dam, Lower Heading.

The Washing Away of a Trestle.



The "Bore" at the Mouth of the Colorado.

Railroad Tracks Undercut by the Colorado.

New Bed and Channel of the Colorado.

Railroad Wreckage on the Shores of the Salton Sea.

Falls in New River, Showing How the Colorado was Cutting Out, by Recession, a Gorge Similar to That at Niagara.

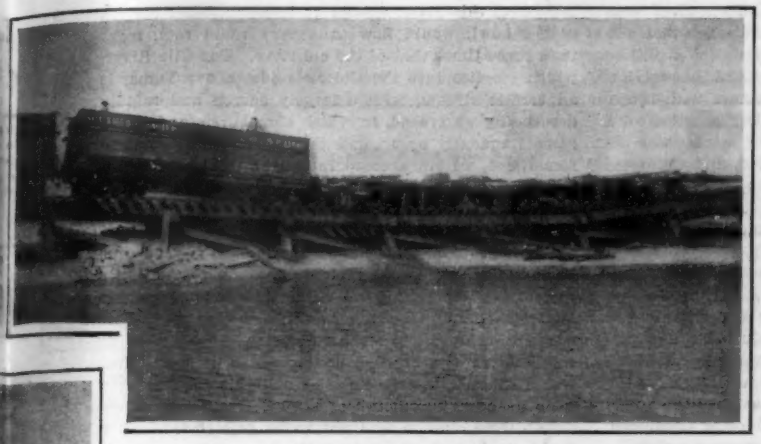
Destruction of the Railw

A GREAT RIVER GONE ASTRAY. RESTORING THE COLORADO RIVER I

mate $700,000,000; and second, that the yardage which has actually been removed by the rush of water to the Salton Sink is probably several times greater than will have to be moved in digging the Panama canal.

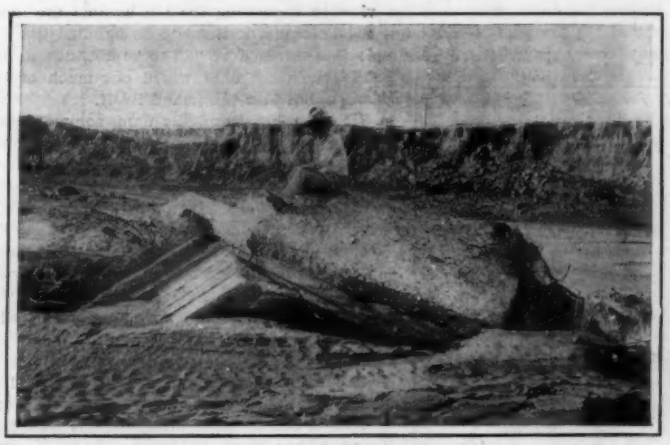
The Colorado River is not popularly known as one of the great rivers of the United States; but when one realizes that it drains an area equivalent to nearly one-fifth of that of the whole United States, namely, all that great territory lying between the Rocky Mountains and the Sierra Nevadas, and extending from the watersheds of the Yellowstone to the Gulf of California, one realizes that the Colorado River, as though resenting the fact that its importance has been overlooked, has of late been demanding its due share of public attention.

There is said to be a heated rivalry as to whether Lordsburg, New Mexico, or Yuma, Arizona, is the hottest place in the United States. The popular verdict,



Railroad Wreck at Lower Heading.

Constructing Mats for Closing the Break.



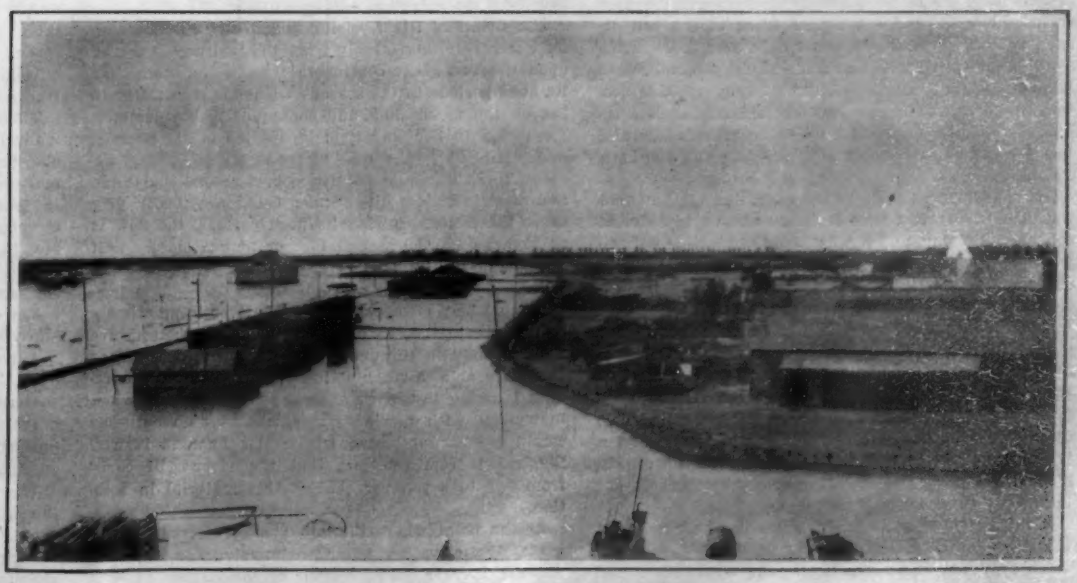
Erosion in New River.

Snapshot of Falling House at Mexicali.

Making Brush Mats for Closure Works.

Banks of New Channel Cut by the Colorado.

Calexico and Mexicali.



Before the River Cut Through at Mexicali.

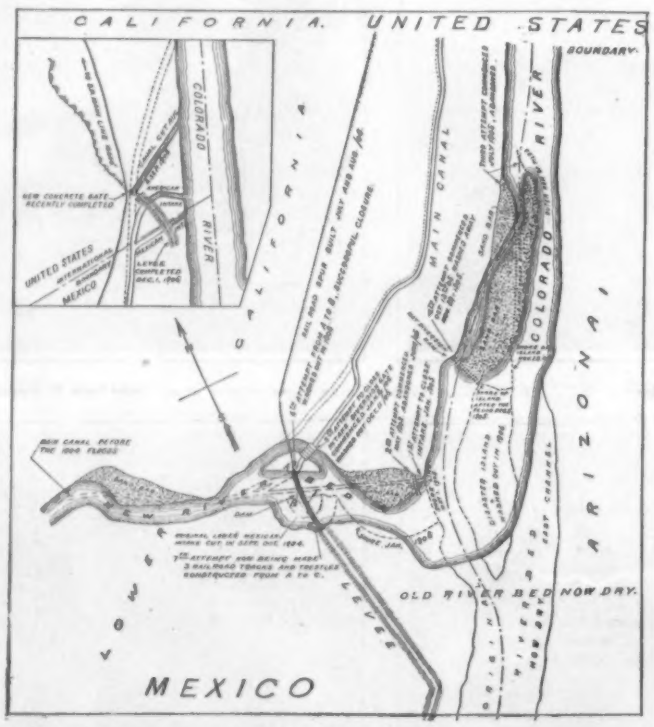
ITS NATURAL CHANNEL AND THE EXTINCTION OF THE SALTON SEA.

however, has conceded the palm to Yuma. Beyond question the desert of Sahara is popularly regarded as the hottest, most arid, and hopeless place on earth; but meteorological observations of rainfall and temperature are said to award this distinction to the famous Salton Sink, approximately one hundred or more miles west of Yuma, which has the peculiarity of a minus elevation as regards sea level, being 287 feet below the universal datum, and probably one of the deepest depressions on the face of the earth unfilled by water. So arid was a large part of this region, that it did not produce any more vegetation than the paved streets of New York. To all appearances, it was merely a dried-up mudhole, black, cracked, and baked.

But, uninviting as the soil appeared, some one discovered that if water could be obtained for irrigation, it was of marvelous fertility and richness, being, in fact, the cream of the soil of the vast plains drained by the Colorado River, which had been carried down by the river in the form of silt and deposited there in ages past, and that the temperature in this region, which is said to reach as high as 170 degrees in the sun, would aid and abet the growth of vegetation to the utmost degree under such conditions, making practically an open-air hothouse.

In 1896 a project was inaugurated and incorporated under the name of the California Development Company, to divert a part of the waters of the Colorado River and lead them into the Imperial Valley, an upper bench of the Salton Sink. Nature had invited this proposition, and had done a good deal of the engineering, and even construction work, in advance, for the Colorado River, at its periods of greatest floods, occasionally overflowed its banks about twelve miles below Yuma, and had cut a flood-water channel many miles in length across the country toward the Imperial Valley, which made practically a natural, ready-made, and excavated canal. And it was only necessary to tap the river and turn its waters into this canal, to cause them to flow for practically fifty miles in the desired direction without much additional work.

In 1900 the California Development Company tapped the Colorado several miles above where the dry channel of the Alamo met the Colorado, a headgate was put in and an artificial canal was cut parallel with the river and from 800 feet to 5,500 feet distant, connecting with the Alamo River or channel. Between the headgate and the Alamo River ran the International Boundary Line between the United States and Mexico. The water was diverted in the United States line, ran across the border in the artificial canal, thence into the Alamo, and for some distance through Mexican territory, and finally back into the United States and Imperial Valley. At Sharp's Corners diverting ditches were cut, headgates and controlling works were put in, together with laterals and the details of an irrigation project. Owing to the necessity of getting the water into the Imperial Valley at a specified time, the headgate was put in higher than was originally planned, and above the water level at low stages. As a consequence, there were times when it was difficult to obtain water.




MAP SHOWING THE LOCATION OF THE VARIOUS ATTEMPTS TO CLOSE THE BANKS OF THE COLORADO RIVER.

The introduction of water into the Imperial Valley proved its soil to be possessed of marvelous fertility; so much so that a crop of alfalfa could be cut every six weeks, and vegetables and crops grown almost as fast as they could be planted, mature, and be harvested. Naturally, the productiveness of the soil attracted dwellers, and in a short time over 2,000 farms were under cultivation, and some 12,000 people became residents in the valley. Within a few years this section had grown from an arid and almost hopeless region, and become second only to San Francisco and Los Angeles as a producer of freight for the Southern Pacific Railroad.

But a serious obstacle to the operation of the canal was met in the fact that it would silt up in spite of constant dredging, and it was found difficult, if not impossible, to get water enough to irrigate the lands already under cultivation whenever this emergency occurred. By way of remedy, in the fall of 1904 a ditch was cut from the Alamo channel at a point about four miles below the original headgate to tap the Colorado direct at a lower level, and get water into the canal at the low stages of the river. The river fall here approximates one foot and two-tenths feet per mile. This ditch was 11 feet deep, and 50 feet in width, and a little over 3,000 feet long; but in spite of its dimensions, it rapidly silted up. The channel was again cut open, only to close itself as before.

A third time it was opened, but a flood occurring at this time in the Colorado, widened and deepened the ditch until very soon practically the whole river had deserted its old channel and begun to flow across country, leaving its bed dry and some eighty miles of its old estuary waterless. Then came a long series of efforts to stop this breach, which it was found necessary to close entirely.

The first attempt consisted of a series of piles driven some three feet apart, filled in with brush and weighted with bags of sand. This dam was unsuccessful for the reason, it is said, that the supply of bags gave out before the work could be completed, and what had been done was destroyed. This failure indicated that the task was a greater one than had been anticipated.

The second method adopted consisted of driving piles and damming against them as before with brush weighted with bags of sand. But as fast as piles were driven on one side of the opening, the current was deflected to the other bank, which eroded, and the opening remained practically as it was, simply changing its location in advance of the brush and in advance of the closure work. This attempt was abandoned after about one month's work.

The Salton Sink had become flooded during these brief operations to such an extent, that it became necessary to move the tracks of the Southern Pacific Railroad. The problem had now assumed grave proportions. Self-preservation being the first law of a railroad as well as of man, it became necessary for the Southern Pacific to take hold of the task, the funds of the development company having become exhausted. Col. Epes Randolph, the resident vice-president of the Southern Pacific Railroad at Tucson, Arizona, an eminent and tried engineer who had fought the floods of several Southern rivers, and built one of the first railway bridges across the Ohio River, now took charge of the undertaking, and Mr. C. E. Rockwood, a civil engineer who conceived the idea of this irrigation project, was made chief engineer in charge of the work.

To give an idea of their task, it seems desirable to look over the situation and conditions.

The Colorado River, rising practically in Montana, its water resulting largely from the melting of snows upon the two great continental ranges, naturally has its flood periods in the seasons when the snow is melting on the mountains; and consequently the summer, from May to September, is the period of its greatest flow. And as is the case of many rivers in arid regions, there is a vast difference between its maximum and minimum flow, the former being practically fifty times the latter. During its flood periods, the flow is as high as 120,000 second feet or approximately half the flow of the Niagara River where it passes over the falls.

It must be remembered that this river is practically bottomless, in the sense that its sides and bottom are nothing but silt, through which no boring or pile has ever been able to reach solid bottom. This silt, moreover, is as fine in texture as flour and melts away, when in contact with flowing water, almost as readily as would a mass of brown sugar. Its fineness is well illustrated from the fact that the river will carry from two to seven per cent of this material in solution.

At the point where the cut, above referred to, was made, the elevation is approximately plus 118 feet above tidewater. The bottom of the Salton Sink is minus 287 feet, and the river at this part of its course is running high along the edge of a great bowl, of which the Salton Sink is the bottom. Like many other silt-laden rivers, the Colorado River has raised itself above the level of the surrounding country, and has been known to raise its bottom as much as seven feet on the gradual subsidence of a single flood. This would be cut away to a large extent by the next recurring flood; but it will be seen that with a fall of some 400 feet to the Sink, this river, should it break through the lip of the bowl, would flow at a very rapid rate, more than three times that of the old river. The Gila River, which empties into the Colorado just above Yuma, is an erratic stream, with a largely barren and rapidly descending watershed, in which cloudbursts and heavy rains frequently occur, and the bed of this river will sometimes, within a comparatively few hours, change from the condition of a dry channel to that of a raging torrent, discharging as much water as the Colorado itself.

The next effort was somewhat after the method used in the Mississippi and Eads jetties. A row of piles was driven along the American side of the river to Disaster Island, with the expectation that sand bars would form on the Mexican side below, thus increasing the flow in the other channel, which it was hoped would cause it to take its old course also and make a deposit across the mouth of the cut.

But the Colorado was not to be cajoled, and by a rapid rise practically dug up the piles.

A second row of piles was tried farther up the river, with the view to depositing the silt against the lower row; but the Colorado declined to be handled like the Mississippi; this third effort had to be abandoned, and the river not only wiped out much of the work, but also the island itself.

Next a brush-and-pile dam, some 600 feet long, was built across the Mexican channel, and when it was nearing completion, the second largest rise in the recorded history of the river occurred and wiped it out.

Next a wooden headgate was built on the bank of the crevasse as a means of controlling the river, which was to be turned through this headgate while closure was made. Although this work was pushed with all possible expedition, it was not completed in time to turn the water through, and mend the break, before the summer floods of 1905 arrived. These were particularly heavy, and opened the crevasse alongside the headgate, which was originally 600 feet wide, to something like 2,600, depositing a solid bank meantime in front of the headgate for some 1,500 feet.

The problem now took the shape of building a dam across an opening nearly 3,000 feet long; and it became necessary to construct some five miles of levees along the bank downstream and some 3½ miles upstream to connect the wooden headgate with the concrete headgate. Also it was necessary to deepen the old canal for some 3½ miles, and cut a new canal about 600 feet in length, to let the river into the new headgate, or bypass, which had practically been built on dry land. Some 300,000 yards of material were to go into the dam, and 400,000 into the levees. A track was now put in from the Southern Pacific Railroad to the site of the dam. Quarries were opened, clay and gravel pits developed, and preparations were made for the weaving of great mattresses and fascines to aid in the closure.

Particularly heavy was the rainfall in 1906, and the Salton Sea raised to a height that it would have taken three years of ordinary rainfall and river flow to reach. This necessitated a removal to higher ground of some forty miles of the Southern Pacific Railroad tracks some three or four times in succession.

The scene now became one of tremendous activity. Hundreds of teams, two dredges, and several steam shovels were at work; 600 feet of the opening was mattressed; a line of piles was driven; brush fascines 18 inches in diameter and 100 feet long were constructed, and held together on foundation cables 5/16 feet in diameter, and the whole dumped against piles driven at intervals across the opening. But the current scoured out beneath the mattresses, and the bulkheads of pile and brush reinforcing the ends of the mattresses.

A trestle carrying the railroad tracks was thrown over the center line of the mattress and along the center of the proposed dam. Carloads of rock and gravel were dumped by the hundred. The river was drained, and finally the entire volume of the river was passing through the wooden headgate.

The Colorado declined again, however, to submit to the dictates of man, and a flood brought down large quantities of driftwood, which lodged against the gate, inducing a scour against sides and bottom.

Spur tracks and materials were rushed with all expedition, and an attempt was made to fill the gate with rock to hold it down and save it, when, suddenly, the

water broke under and some 120 feet of the gate rose from its place and floated downstream a hopeless and unrecognizable wreck, and lodging some distance below. Thus ended the fifth attempt.

The best previous practice seeming to be useless in endeavoring to cope with the Colorado River, Col. Randolph and his assistants determined to conquer the river the next time by main strength. Three lines of trestle, each to carry a railroad track, were projected across the breach, parallel with each other, and preparations were made to dump vast quantities of rock, as large and as heavy as could be obtained, and make three rockfill or cascade dams, one parallel with the other across the bypass opening, thus throwing the water across the larger opening of the old dam or break. Every facility and resource of the great Southern Pacific Railroad was now utilized; every quarry within 400 miles was requisitioned; and some 200 carloads of rock were rushed in and dumped into the break daily. This work began on November 24, and in twenty-one days every drop of water was cut off and the water was forced down the old channel of the Colorado River where it belonged, and the break was closed. Meanwhile the needs of the Imperial Valley were taken care of by water passed through the new concrete headgate, and apparently the Colorado River had capitulated and surrendered to engineering skill and man's authority.

The Colorado, however, was equal to another insurrection. It made an attack below this dam, which held its own, but broke through the levee below; turned around behind it; cut it away and part of the dam from the back; and, within a few weeks, all previous efforts had been set at naught, and the entire body of the river was flowing unimpeded into the Salton Sink through an opening about two-thirds of a mile in width.

The seventh attempt at closure was begun in earnest on January 27. Three lines of trestles, resting on piles 65 to 90 feet in length, were built across the break with much difficulty, a portion of one of these trestles being swept away three times. Indeed, it was found necessary to weight the piles down with water tanks to keep them from being carried away.

In the sixth attempt at closure, 2,200 cords of brush and three-fourths of a mile of railway, over 1,000 piles, and some 200,000 yards of rock and gravel and other material were used. But the last contest was still more severe, calling for the services of 375 Indians, 400 Mexicans, and 500 white men, seven locomotives and a steamboat, and dredges; also 100,000 cubic yards of rock and 75,000 yards of clay and gravel were hauled out on these trestles and dumped overboard; thus making a cascade dam; raising the level of the river some 12 feet, and throwing it back into its old channel, into which it began to flow about February 26. After so many unsuccessful attempts, the question still remains, "Will this closure be permanent?"

Advices received by the writer from Mr. Randolph on April 2 advise that "the new work and the new levees have stood a 27-foot stage of water in the Colorado River." He writes that the muck ditches have proven effective in preventing the water from passing under the levees; but he says this may not be the condition when there is a maximum of 33 feet on the Yuma gage, though he believes that the levees will prove effective, even against this height.

The writer considers that in overcoming the Colorado River, Col. Epes Randolph and his able assistant, Mr. H. T. Cory, have won one of the greatest engineering victories and performed one of the most remarkable and difficult engineering feats ever accomplished, and that engineering is the richer for their demonstration of the efficiency of the cascade dam for controlling obstreperous rivers. He considers further that the people of Mexico, California, and Arizona, if not of the nation, owe many thanks to the Southern Pacific Railroad for taking hold of a bankrupt enterprise and furnishing men, money, and physical equipment and saving such large and important vested and property interests.

## THE JAPANESE SQUADRON AT JAMESTOWN.

(*Continued from page 373.*)

partures, ammunition passages have been dispensed with and a new arrangement has been made instead, special ammunition hoists being provided for the 12-inch guns. The forward conning-tower has no side entrance at the back of its wall, but is entered from the upper bridge through a trap-door on the roof of the tower. There are smaller conning towers also over the 6-inch guns on the upper and main decks to control the gun fire. Her great width, which is 75 feet, was probably a record in cruiser construction at the time she was designed. The "Tsukuba" is the first cruiser ever equipped with 12-inch guns, of which she has four—two in the forward and two in the after barbettes on the upper deck. Besides, the ship carries twelve 6-inch quick-firing guns, an equal number of 4.7-inch quick-firers, two 12-pounders, and four Maxims. She can bring four 12-inch guns, six 6-inch guns, and six 4.7-inch guns to bear in broadside fire. As to the fore fire, the cruiser can most effectively train two 12-inch guns, four 6-inch guns, and four 4.7-inch guns.

Although no official statement of her steam and gun trials has been given to the public, this much is absolutely certain, that not only was everything satisfactory but in some important respects the results of the trials exceeded expectations. Her maneuvering power is said to have proved exceptionally good, the ease with which she was steered and handled to have been very remarkable, and even the rough weather which she experienced at the time failed to make her roll to any perceptible degree. In all her gun trials the results were, according to accounts, all that could have been desired.

A correspondent on board one of the ships writing to the Jiji-Shimpo under date of the 2d instant says: "Although we encountered very rough weather on the day we left Yokohama, the behavior of the 'Tsukuba' was splendid and she neither rolled nor pitched in the slightest degree."

Vice-Admiral Ijuin, commander-in-chief of the Celebration Squadron, sprang from the warlike clan of Satsuma, which produced Saigo, Okubo, Togo, and many other heroes. He was born in 1852 and took part in the War of the Restoration when he was quite young. In 1871 the vice-admiral attended the Naval College, Tokio, and six years later he was sent to England to prosecute his naval studies. While there he served on board the British warship "Triumph" and was also admitted to the Greenwich College. In the time of the Japan-China war, the vice-admiral was a captain and held the post of naval staff officer at the imperial headquarters. In March, 1902, he was appointed commander of the Standing Squadron, and was sent to England in command of the "Asama" and the "Takasago" to participate in the ceremonies in connection with the coronation of King Edward. In September, 1903, he was promoted to the rank he now holds and appointed vice-chief of the Naval Staff Office under Admiral Viscount Ito. During the Russo-Japanese war, he was put on the naval staff of the imperial headquarters and took part in its councils, doing distinguished services to the state, for which he was awarded the first-class order of the Golden Kite with the Grand Cordon of the Rising Sun. In November last the vice-admiral was transferred to his present post of commander-in-chief of the Second Squadron. He is the inventor of a special fuse, which made possible the use of the Shimose explosive. During the late war, Capt. Takenouchi, commander of the "Tsukuba," commanded the "Nisshin," and Capt. Yamaya, commander of the "Chitose," commanded first the "Akitsushima" and then the "Kasagi," both rendering meritorious services which were duly recognized. The crews of the two cruisers are most of them men who took part in the war.

According to the itinerary already published, the squadron is expected to arrive at Jamestown on May 8 and to stay there for about twenty days, after which it will visit New York, London, Wilhelmshafen, and Cherbourg. The warships will return to Yokohama in November.

## RECENTLY PATENTED INVENTIONS.

### Pertaining to Apparel.

SLEEVE-HOLDER.—HERMINIA M. M. BARNES, Ludlow, England. This device maintains short or elbow sleeves in place when putting on an outer garment. The sleeve is bindingly held to the arm by an elastic tape having a ring secured at each end thereof, with one end of the tape passing through one of the rings to form a loop by which the sleeve is embraced about the arm and the other ring serving as a means to be passed over the thumb or finger for maintaining the holder in operative position.

BOW-NECKTIE.—W. A. CLARKE, East Ham, London, England. The more particular object in this case is to produce a "bow-necktie" provided with means whereby it may be fastened upon the outer flaps of a turn-down collar. One advantage of the tie is that persons of different tastes may mount it in different positions relatively to the collar.

### Electrical Devices.

SECONDARY-BATTERY PLATE AND METHOD OF MAKING SAME.—L. N. J. ROSELLE, 14 Rue de la Fidélité, Paris, France. The invention consists, broadly, in forming by fusion, casting, and molding a core of active material and in casting around this core a support presenting the form of a grid with multiplying ramifications, this support being cast in a mold the core of which is constituted by the core of active material itself, which, as indicated, has previously been cast.

TROLLEY STAND AND POLE.—G. Q. SEAMAN, New York, N. Y. This trolley-stand will operate automatically to depress the trolley-pole in case the trolley-wheel becomes displaced from the wire, the general purpose being to prevent injury to guy-ropes or overhead construction. Means are provided for mounting the trolley-wheel which will enable it to be detached readily by the overhead construction in case it becomes fouled therewith. In this way the dislocation of the pole from the stand is prevented.

### Of Interest to Farmers.

PNEUMATIC COTTON-HARVESTER.—J. E. WORSWICK, Montgomery, Ala. This picking-machine is of novel construction and arrangement of picking-nozzles, and of novel construction and arrangement of the receiving-chamber with provision for drying wet cotton and removing sand and dirt and condensed water and in the novel construction and arrangement of suction and blowing fans in connection with a motor, and in the novel construction and arrangement of a ventilated storage-receptacle and its accessories.

THRESHER-FEEDER.—T. N. JOHNSEN, Clark, Wash. Straw is carried to the machine and lifted into the hopper. Straw is dropped onto the hoe-down by forks. Rollers tear the bunches apart, throwing them out on endless carriers in the hopper sides, which deliver them through the opening in the bottom of the hopper onto an endless carrier, thence to the draper and to the machine. By means of a swinging-frame the feed of the same carrier to the draper is regulated, since the adjacent run of the carrier on the frame and former carrier move oppositely, and by swinging the frame nearer or farther from the same the layer of straw delivered may be nicely regulated.

ROOT AND STALK PULLING MACHINE.—J. L. ANDERS, Pittsbridge, Texas. In this patent the invention relates to implements for clearing the earth of stalks, roots, vines, etc. The object of the invention is to produce an implement which will be drawn along by horses and which may be easily operated by the driver, so as to dig roots or stalks from the ground.

### Of General Interest.

LIFE-RAFT.—P. C. PETRIE, New York, N. Y. The essential object of this invention is to provide a practically indestructible life-raft with a maximum passenger-carrying capacity proportionate to its size. These rafts may be fitted for use on seagoing craft by supplying them with lockers for the necessary stores of food, water, signals, etc. Mr. Petrie finds "Palo de balsa" the wood best adapted for the raft.

TIMBER-CUTTING DEVICE.—E. C. POLLARD, Seattle, Wash. This device is for use in cutting timber by burning a well-defined kerf through the log or tree. The invention more particularly relates to means for directing a blast of air to promote combustion and for preventing the timber from burning at other points than those required for severing it.

PROCESS OF MAKING HYDRAULIC CEMENT.—E. MUELLER, Aisen, N. Y. The process consists in mixing together pulverized coal and a pulverized flux and feeding the mixture simultaneously into the kiln for calcining the cement clinker, the admixture of flux with the coal and its diffusion and immediate action throughout the kiln serving to calcine the cement at a lower temperature and in a shorter time.

### Hardware.

NUT-LOCK.—G. W. ROBERTS, Minersville, Pa. The object of the invention is to provide a nut-lock for securely locking the nut in place after it is screwed up and to allow convenient unscrewing of the nut whenever it is desired to do so and without destroying any of the parts, thus permitting free use of the bolt, nut, and lock.

SAFETY-LOCK.—J. E. LEDFORD, Butte, Mont. In this patent the invention has reference to locks—such, for instance, as are used upon doors, windows, and analogous closure members—Mr. Ledford's more particular object being to provide a lock with means for preventing its being picked or actuated surreptitiously.

CLASP.—O. FISHER, Sloan, Iowa. In this case the invention is an improvement in clasps, more especially designed as a means for holding the sections of stovepipes together, although not limited to this particular use, as it may be employed with advantage in other relations, where a safe, strong, and durable clasp is desired.

FARRIER'S KNIFE.—D. R. BALDWIN, Ravenden Springs, Ark. This patentee's improvement, generally stated, consists in a thin double-cutting-edged paring-blade adapted to be pivotally attached at the bottom of an animal's hoof and positively held in adjusted relation thereto as it is swung on its pivotal connection to remove the outer surface.

### Household Utilities.

CREAM-SEPARATOR.—S. W. STEWART, Spencer, Ind. The invention is a novel device for separating the cream that rises to the upper surface of milk, and is especially designed for drawing off the cream that collects at the top of milk-bottles, as delivered for family use, thus adapting it for a household convenience and desirable kitchen article.

WASHING-MACHINE.—J. W. SNIPERT, East Point, Ga. The machine is of that type employing a revolving drum in which the clothes are placed, and the patentee constructs the drum with certain special features designed to give increased efficiency. The hinged cover of the machine and the revolving drum are so arranged in connection with a pivoted lever that the latter may be shifted so that the cover is raised and the drum lifted from the machine and caused to move outward and be supported on the lever.

### Machines and Mechanical Devices.

CONDUIT-TRAVELER.—L. D. SHAFFER, Paint Borough, Pa. In this case the machine is adapted for drawing heavy cables through conduits. The invention provides means for withdrawing or slightly retracting the entire wiring machine when desired, as it sometimes happens in using the device in a conduit that something gets out of order or an unusual obstruction is met with and it is desired to withdraw the machine.

LINE-CARRIER.—L. D. SHAFFER, Paint Borough, Pa. In the present patent the invention is an improvement in line-carriers, especially designed for use in stringing wires after the first wire has been strung, as well as for carrying wires, lines, and the like across an intervening space having a wire for supporting the device.

### Railways and Their Accessories.

APPLIANCE FOR SHIFTING THE POINT OF APPLICATION OF THE WEIGHT ON THE TRUCKS OF CARS AND THE LIKE.—P. STEFFEE, Missoula, Mont. The invention is for the purpose of bringing the entire weight of the car body to bear on the driven wheels of the car truck or those wheels to which power is first applied in putting the car in motion. By this arrangement of means the traction of the driven wheel will be increased, thereby avoiding slipping and enabling the car to be started without delay. Using this appliance materially decreases the weight of the car-body and sanding the track will be seldom required.

RAILWAY SAFETY APPARATUS.—G. E. RYAN, New York, N. Y. The improvement refers to safety appliances or apparatus, and is intended to be used upon railways to prevent collisions. The arrangement is such that the

apparatus will operate to prevent head-on as well as rear-end collisions, and the devices employed are entirely automatic in their operation.

CAR RAIL AND BED.—R. JACKSON, Kennett Square, Pa. The objects in this case are to provide a rail having the maximum amount of wearing surface for the minimum weight, and to provide a rail bed which is not subject to decay and to which the form of rail may be readily applied. A further object is to provide a rail and bed in which additional parts for securing the ends of the rails together are unnecessary and in which only ordinary fastenings need be applied at the ends or into intermediate portions of the rail.

RAIL-JOINT.—J. C. ABBOTT, Pittsburg, Pa. The object of the invention is to provide railroad rails with an improved form of joint whereby their meeting ends are firmly yet detachably connected without the use of fish-plates and bolts or other form of fastening independent of the rails themselves. The joint may be cheaply produced for manufacture.

### Pertaining to Vehicles.

DUMPING-WAGON.—R. A. SHOWERS, Shenandoah, Iowa. The objects among others in this invention, are to provide a wagon operated by the driver without shifting his position to carry the body of the wagon, together with its load, rearwardly and inclinedly rest it at the required point of discharge; also to provide means for releasing and unlocking the tail-gate of the wagon from the driver's seat.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Notes and Queries.

### HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10518) A. H. C. asks: I have a small dynamo—12-volt—which runs easy enough when the current is open, but as soon as the current is closed it runs so hard as to be nearly impossible to keep in motion. I suppose this is due to magnetic attraction. Can you suggest a remedy? A. Your dynamo is all right. It ought to run hard when doing work. When no current is flowing, there is no resistance to motion, and of course the shaft turns with ease. No current is being generated. When current is being used, work must be done to furnish the current. The power required to light ten 16-candle-power lamps is equal to that of one horse. A man might be able to furnish a tenth as much for a while. You only say that your dynamo current has 12 volts pressure. This does not tell anything about the current. Had you also given the amperes, we could have given you the power needed to drive the machine at full speed.

(10519) D. H. asks: If a convex piece of ice could be frozen clear enough, not to scatter the rays of the sun, so as to come to a focus, will not the ice produce the same effect as a sun glass? If so, if some material that will ignite where the rays of light focus, is not the heat produced by the gathering and focusing of the rays produced by the convex surface caused by the sudden stopping of the rays, or do the heat rays actually pass through the ice? If the theory is void that the heat of the sun is produced by the stopping of the rays when they strike the earth, why would not the heat be spent by passing through the atmosphere before they reach the earth? A holds that heat from the sun is produced by the stopping of the rays of light. B holds that the rays give off the heat as it passes through the atmosphere. Which, if either, theory is correct? If neither is correct, will you please state correct theory, as to how the heat is given off. A. If a lens, or sun glass, as you call it, were made of ice, it would bring the rays of the sun to a focus, and the focus would be hot just as it is when a lens of glass is used. Lenses of ice have frequently been made. The heat rays of the sun pass readily through ice and glass, just as they do through the air. How could the air of a room be warmed by the sun, if the heat of the sun did not pass through the glass of the windows? Nor is the heat, which we can so easily feel when the sun shines upon us, lost in the air or in the space between us and the sun. The atmosphere of the earth absorbs a part of the heat of the sun, but the greater part comes through to the surface of the earth and warms it. The heat of the sun is produced in the sun, and comes to the earth from the sun. The earth stops the rays, or waves, as they would better be called and makes them sensible to our nerves. It is true that the heat of the sun would not be felt here, if there were no earth for them to strike. The rays would go on till they found something to intercept them, before they could be made evident or manifest.

(10520) W. M. B. writes: It seems to me that in your reply to Query No. 10424 you ought not to say that the moon *revolves on its own axis*. Of course, it is only a question of the proper *expression*, as everyone is agreed as to the facts. It would be just as proper to say that the Flatiron building in New York revolves on its own axis as to say that the moon does. Both would appear to revolve in precisely the same way if seen from some point in space. The *axes of both* revolutions are the center of the earth. But of course if your statement is correct, I shall have to admit that my head revolves on its own axis, which may account for my waking up some morning with a lame neck. A. Several esteemed correspondents have taken exception to the statement that the moon rotates on its own axis. One has written us four letters on the matter. We make an additional note on the subject. No, it is not proper to say that the moon *revolves* on its own axis; nor did we say that it did. The friend of our correspondent who sent in the question said it in the words quoted, and we cannot be held responsible for that. *Revolve* is strictly limited in astronomy to the motion of a heavenly body in an orbit. The earth revolves around the sun. *Rotate* is limited to a motion around an axis. The moon rotates on its axis. Our correspondents who object to our answer do not seem to know the usage of these words in astronomy. Now, a final word on the subject. The sun rises on every point of the moon, passes over the planet, and sets once a lunar month, just as it does on the earth every day. If this does not show a rotation on an axis respecting the sun and all outside space, we fail to understand simple motions. We will quote an authority than whom there is no higher, Prof. C. A. Young, "College Astronomy," "Rotation of the Moon," Sect. 248: "The moon rotates on its axis once a month, in precisely the same time as that occupied by its revolution around the earth. In the long run it therefore keeps the same face toward the earth. It is difficult for some to see why a motion of this sort should be considered a rotation of the moon, since it is essentially like the motion of a ball carried on a revolving crank. See Fig. 1. Such a ball, they say, *revolves* around the shaft, but does not *rotate* on its own axis. It does rotate, however. The shaft being vertical and the crank horizontal, suppose that a compass needle be substituted for the ball, as in Fig. 2. The pivot turns underneath it as the crank whirls, but the compass needle does not rotate, maintaining always its own direction with its marked end north. On the other hand, if we mark one side of the ball in Fig. 1, we shall find the marked side presented successively to every point of the compass as the crank revolves, so that the ball as really turns on its own axis as if it were whirling upon a pin fastened to a table. The ball has two distinct motions by virtue of its connection with the crank: first, the motion of translation, which carries its center of gravity, like that of the compass needle, in a circle around the axis of the shaft; secondly, an additional motion of rotation around a line drawn through its center of gravity parallel to the shaft. A body *rotates* whenever a line drawn from its center of gravity outward, through any point selected at random in its mass, describes a circle in the heavens." We leave the subject with this quotation.




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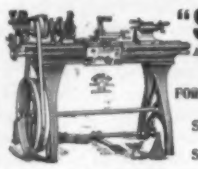

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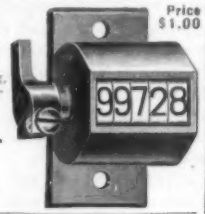


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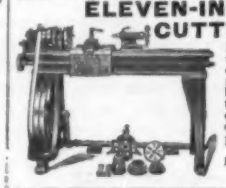

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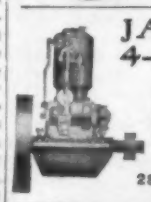

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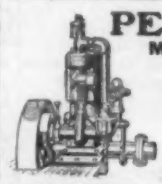

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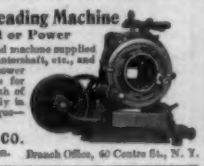

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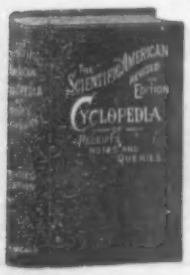


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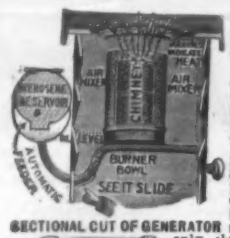


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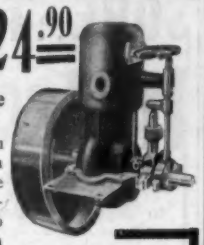

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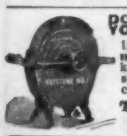

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Clamping mechanism to be applied to spud of dredge; Patented, December 31st, 1901.

Improvement on dredge to reinforce and reduce the weight of and facilitate the manipulation of dipper-handle of an excavator; Patented, October 9, 1906.

Improvement on dredge to positively control the movements of the dipper and dipper-handle of a dredge, as well as to render the dredging operation more effective; Patented November 27th, 1900.

Improvement on means of controlling the operation of excavating dipper and dipper-handles; Patented September 4, 1906.

Improvement on dredges whereon turntable is employed for the purpose of swinging the load from side to side; Patented, September 9, 1902.

Patent on friction brake which avoids the necessity of locking the actuating mechanism, and whose holding power is made the same in either direction of the revolution of the wheel. Patented, June 25, 1906.

Further improvements on means of controlling the operation of dipper-handle of dredge; Patented December 8, 1903.

Improvement on friction brake; Patented February 2, 1904.

Improvement on dredge or excavator to permit the excavation of hardpan with least possible strain on the parts of the machinery; Patented, February, 1906.

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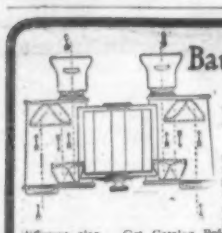

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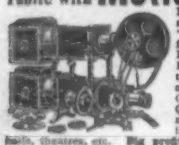

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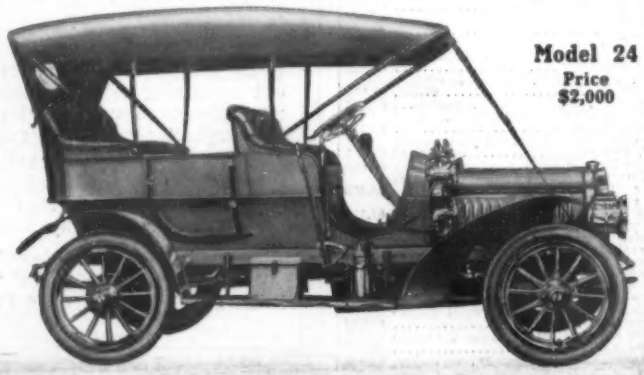

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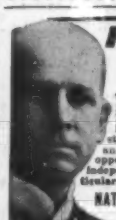

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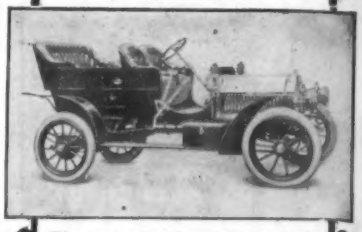

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